JOURNAL OF THE INSTITUTION OF PETROLEUM TECHNOLOGISTS

"Conjunctione potiores."

ABSTRACTS

VOLUME TWENTY-THREE

1937

Published at the Offices of the Institution,
ALDINE HOUSE, BEDFORD STREET,
STRAND, LONDON, W.C.2.

1937

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ABBREVIATED TITLES USED IN THE ABSTRACTS

Abbreviated Title.	*Journal.*
Aircraft Engineering	Aircraft Engineering.
Ann. des Comb. Liq.	Annales de l'office National des Combustibles Liquides.
Ann. des Mines	Annales des Mines de Roumanie.
Asphalt u. Teer	Asphalt und Teer.
Azerb. Neft. Khoz.	Azerbaidzhanskoe Neftyanoe Khozyaistvo.
Beitr. zur Geophysik	Beitrage zur Geophysik.
Bohrtech. Z.	Bohrtechniker Zeitung.
Bol. Geol. y Min.	Boletin de Geologia y Mineria (Caracas).
Bol. Inform. Petroleras (B.A.)	Boletin de Informaciones Petroleras (Buenos Aires).
Brenn.-Chem.	Brennstoff-Chemie.
Bull. Amer. Assoc. Petr. Geol.	Bulletin of the American Association of Petroleum Geologists.
Bull. Assoc. Française T.P.	Bulletin de l'Association Français des Techniciens du Pétrole.
Bulletin de Mathematique et de Physique, Bucharest	Bulletin de Mathematique et de Physique, Bucharest.
Bur. Stand. J. Res.	U.S. Bureau of Standards Journal of Research.
Calif. Oil World	California Oil World.
Canad. Inst. Min. & Met. Bull.	Bulletin of the Canadian Institute of Mining and Metallurgy.
Chem. Met. & Min. Soc. S. Africa	Chemical, Metallurgical and Mining Society of South Africa.
Chem. Rev.	Chemical Reviews.
Chem. Trade J.	Chemical Trade Journal.
Chem. and Ind.	Chemistry and Industry.
Chim. Ind.	Chimie et Industrie.
Chimica e Industria	La Chimica e l'Industria.
Compt. rend.	Comptes rendus hebdomadaires des Seances de l'Academie des Sciences.
Compt. rend. Geol. Petr. (Strasbourg)	Compte-Rendu des Séances du Groupe des Géologues Pétroliers de Strasbourg.
D.E.U.A.	Diesel Engine Users Association.
Direccion Minas y Geol.	Publication of Direccion Minas y Geologicas, Argentine.
Drilling & Production Practice	Drilling and Production Practice.
Engineer	Engineer.
Engineering	Engineering.
E.P.	English Patent.
Fuel	Fuel in Science and Practice.
Fuel Economist	Fuel Economist.
Gas & Oil Power	Gas and Oil Power.
Groz. Neft.	Groznenskii Neftyanik.
Ind. Eng. Chem.	Industrial and Engineering Chemistry.
Ind. Eng. Chem. Anal.	Industrial and Engineering Chemistry, Analytical Edition.
Instruments	Instruments.
Iva	Iva.
J.A.C.S.	Journal of the American Chemical Society.
J. Applied Chem. (U.S.S.R.)	Journal of Applied Chemistry (U.S.S.R.)
J. Applied Physics	Journal of Applied Physics.
J.C.S.	Journal of the Chemical Society.
J. Fuel Soc. Japan	Journal of the Fuel Society of Japan.
J.I.P.T.	Journal of the Institution of Petroleum Technologists.
J. Org. Chem.	Journal of Organic Chemistry.
J. Phys. Chem.	Journal of Physical Chemistry.
J. Roy. Aer. Soc.	Journal of the Royal Aeronautical Society.
J.S.A.E.	Journal of the Society of Automotive Engineers.
J.S.C.I.	Journal of the Society of Chemical Industry.

Abbreviated Title.	*Journal.*
Khim. Tverd. Topliva	Khimiya Tverdovo Topliva.
Michigan Dept. of Conservation, Geol. Surv. Division, Progress Report	Progress Report of the Michigan Department of Conservation, Geological Survey Division.
Min. & Met.	Mining and Metallurgy.
Chem. Weekblaad	Chemisch Weekblaad.
Mining Magazine	Mining Magazine.
Mon. Petr. Roum.	Moniteur du Petrole Roumain.
Montan. Rundschau	Montanistische Rundschau.
Natural Gases U.S.S.R.	Natural Gases, U.S.S.R.
Nat. Petr. News	National Petroleum News.
Neft. Khoz.	Neftyanoe Khozyaistvo.
Nickel Industry	Nickel Industry.
Nov. Neft.	Novosti Neftepererabotki.
Nov. Tekhn. Bur.	Novosti Tekhniki Bureniya.
Nov. Tekhn. Neft.	Novosti Tekhniki Neftedobvichi.
Oel. u. Kohle	Oel und Kohle vereinigt mit Erdoel und Teer
Oil & Gas J.	Oil and Gas Journal.
Oil News	Oil News.
Oil Weekly	Oil Weekly.
Öle, Fette, Wachse	Öle, Fette, Wachse, Seife, Kosmetik.
Olii Min.	Olii Minerali.
O.P.I. Publication	Publication of Osterreichisches Petroleum-Institut.
Paint Manufacture	Paint Manufacture.
Paint Technology	Paint Technology.
Petr. Eng.	Petroleum Engineer.
Petroleum Marketer	Petroleum Marketer.
Petr. Times.	Petroleum Times.
Petr. World (L.A.)	Petroleum World (Los Angeles).
Petr. Z.	Petroleum Zeitschrift.
Physics	Physics.
Pipe Line News	Pipe Line News.
Plant Protection (U.S.S.R.)	Plant Protection, U.S.S.R.
Proc. Assoc. Asphalt Paving Tech.	Proceedings of the Association of Asphalt Paving Technologists.
Proc. A.S.T.M.	Proceedings of the American Society for Testing Materials.
Proc. I. Mech. E.	Proceedings of the Institution of Mechanical Engineers.
Quart. Journ. Geol. Soc.	Quarterly Journal of the Geological Society.
Rec. Trav. Chim.	Receuil des travaux chimiques des Pays-Bas.
Refiner	Refiner and Natural Gasoline Manufacturer.
Rev. Comb. Liq.	Revue des Combustibles Liquides
Rev. Petr.	La Revue Petrolifere.
Riv. Ital. Petr.	La Rivista Italiana del Petroleo.
Roads and Road Constr.	Roads and Road Construction.
Sum. of Operations, Calif. Oilfields	Summary of Operations, Californian Oilfields.
Tekn. Tidskr.	Teknisk Tidskrift.
Terrestrial Magnetism	Terrestrial Magnetism.
Trans. Faraday Soc.	Transactions of the Faraday Society.
Univ. Texas Bull.	Bulletin of the University of Texas.
U.S. Geol. Surv. Bull.	U.S. Geological Survey Bulletin.
U.S. Geol. Surv. Prof. Paper	U.S. Geological Survey Professional Paper.
U.S.P.	United States Patent.
World Petr.	World Petroleum.
Z. Deutsch Geol. Ges.	Zeitschrift der Deutschen Geologischen Gesellschaft.
Z. Prak. Geol.	Zeitschrift zur praktische Geologie.

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Geology.

1. Geology and Economic Significance of East Texas. B. B. Zavoico. *World Petroleum*, 1936, **7** (3), 94–146.—Discovered at the end of 1930, the East Texas field soon became the largest single oilfield in the United States, and, owing to lack of control, it seriously affected the oil markets of the world. It was reduced twice to a very limited production in an effort to impress upon the many operators that uncontrolled development would soon ruin the reservoir and necessitate the use of pumping in a very short time. The estimated reserve is quoted as being 4,500,000,000 brls., and it is expected to continue as a flowing field for another 8 to 9 years.

The field is located on the western flank of the Sabine Uplift, and is 42 miles long and from 4 to 8 miles wide. Production is from the Woodbine Sand at the base of the Upper Cretaceous, and it is probable that soon after the deposition of the Upper Cretaceous the whole of this area was uplifted and the Sabine Uplift formed. The Lower Cretaceous was truncated, resulting in the formation of a peneplain, and the Woodbine Series deposited around the western margin of the Uplift. The material forming this series was derived from the north and north-east. After deposition of the Woodbine and the Eagle Ford Shale series, the sea encroached over the whole of the Uplift well into Louisiana, and the Austin Chalk was laid down, overlapping and sealing the Woodbine Series. Sedimentation then continued uninterrupted except for a small break at the base of the Tertiary. It is generally accepted that the oil originated in the Woodbine and Eagle Ford Series, and that migration up the very gentle dip drained a large area. On the west and north sides of the field several local sand-lenses in the Upper Woodbine or basal Eagle Ford have given rise to small commercial accumulations, each with its own water-table. The Woodbine has an average thickness of 65 ft. and is found at approximately 3200 ft. It is a series of cross-bedded sands and sandy shales locally intermixed with conglomerates and volcanic material. A very high percentage of recovery is expected, owing to its high permeability, and water-drive is considered to be the main source of energy, nearly all the gas present (16·0%) being in solution.

As the East Texas field has practically no structural basis, it is unlikely that production will be found in the deeper formation of Trinity age.

The development history, drilling, production, and refining methods and costs are adequately dealt with. The paper is accompanied by maps, sections and other illustrations. J. A. G.

2. Evidence of Recent Movements along Faults of Balcones System in Central Texas. F. Bryan. *Bull. Amer. Assoc. Petr. Geol.*, 1936, **20**, 1357–1371.—The Balcones system is really a zone of grabens which extend eastward of a line, some 250 miles long, passing through San Antonio, Austin and Waco. The size of these grabens is very variable, but where the larger ones are studied in detail it is found that they are themselves broken up into a series of smaller ones. The evidence of recent movement is based on archæological studies, and shows that in at least one case a displacement of 32 ft. has taken place within possibly the last 4000 years. Present-day movement is suggested by the repeated breaking of the water-pipe to Waco, where it crosses a fault, and by earthquakes at Waco and Wortham.

The character of these grabens would suggest that they represent the initial stage of an uplift. Their effect has been to destroy large parts of pools, such as Richland and Wortham, instead of the faults providing the cause of the accumulation. This is suggested by the oil-stained sands found on the other side of the faults in the fields just mentioned. S. E. C.

3. Comb Coastal Louisiana for Overlooked Reserves in Salt Domes and Oldfields. N. Williams. *Oil & Gas J.*, 19.11.36, **35** (27), 11 and 22.—Many of the salt domes which were drilled for crestal production a few years ago are now being re-drilled on their flanks in an effort to find new reserves. The sands on the flanks of these shallow piercement type domes are very often irregular in their occurrence, and while more

attractive structures remained to be developed these domes were not thoroughly tested for flank production.

Among those recently drilled with success is the Iberia Dome. Wells on the west and south-west flanks have found Miocene production. Port Barre dome has also been proved on the west flank at a depth of 4900 ft. Recent drilling on the southern and western flanks of the Jennings dome has found oil in the Oligocene sands at depths of 7545 ft. and 6380 ft. respectively, and it is hoped that these sands will extend completely round the southern flank. Others are being tested, and it is expected that many more discoveries will be made. J. A. G.

4. Geomorphology of Gulf Coast Salt Structures and its Economic Application. C. H. Ritz. *Bull. Amer. Assoc. Petr. Geol.*, 1936, **20**, 1413–1438.—The data available concerning subsurface structure around salt domes in the N. part of the Gulf Coast suggest that an area of subsidence—a rim syncline—is developed around the intrusive salt body. This is in accord with the results of Nettleton's work on the mechanics of salt-dome intrusion. The apparent lack of such rim synclines in the S. part of the Gulf Coast is probably due to the thick cover of younger sediments having filled and obscured them. The magnitude of the rim syncline is dependent on the volume of salt removed from its mother horizon to form the intrusion. Hence the so-called "shallow" domes which reach nearest to the surface will have the largest synclines.

The effect of such synclines on the migration and accumulation of oil is discussed. A well-developed syncline on the down-dip side of a salt dome will act as a barrier to oil migrating up-dip. The formation of such a barrier may be prevented or modified by the uplift of the sediments by the salt intrusion, the filling of the syncline by later sediments, or by erratic development of the syncline. Accumulation is probable in the relatively unaffected zones between overlapping rim synclines, and examples of this type are discussed. The effect of asymmetric uplift of the salt must also be taken into account. S. E. C.

5. Possibilities of Oil Production in the Illinois Basin. W. V. Howard. *Oil & Gas J.*, 12.11.36, **35** (26), 76, 78, 80, 195.—Since Ordovician times the Illinois Basin has been bounded on the south-west by the Ozark Uplift, on the north by the Wisconsin Highlands, and on the east and north-east by the Cincinnati Arch. The latter structure bifurcated in E. Indiana and separated the Illinois Basin from the Michigan and Pennsylvanian Basins during Palæozoic times. A comparison of the thickness of the sediments in the northern and southern parts of the Illinois Basin points to the conclusion that the southern area sank at a more rapid rate than the northern. This has resulted in unconformities becoming more numerous and important in the north, and in many places the beds have been strongly eroded and overlapped from south to north.

The stratigraphy is as follows: Cambrian; an Ordovician limestone, sandstone and shales series, and a Devonian-Silurian limestone, which varies in type over the basin. Above this there are approximately 1000 ft. of Mississippian limestones and shales containing numerous unconformities. A few sand lenses are also included in this series. The Upper Mississippian is represented by a Flysch material (the Chester Series). This also contains numerous unconformities and lenticular sand bodies. The Lower Pennsylvanian consists of the Pottsville Sandstones and the Carbondale and McLeansboro Series (Coal Measures).

The La Salle Anticline within the Basin appears to be a ridge formed by the tendency for greater subsidence on both its sides. Nearly parallel to this structure is the Centralia-Colmar Trend, on the west side of the Pennsylvanian Basin, and although many oilfields are located on this line, it does not seem to have any tectonic basis. The Waterloo Anticline, which lies to the west of the Centralia-Colmar Trend, is, on the other hand, believed to be a structural feature. Two other N.–S. trends are known: the Siosi Trend (Indiana) and the Ava-Pike Trend (Illinois). Several pools have been discovered on them, and it is thought that they represent pre-Mississippian structures reflected in places by the younger sediments.

Further work will undoubtedly prove many of the structures which are known to

exist in the basin, and production may be obtained from a number of horizons ranging in age from Pennsylvanian down to the Ordovician. J. A. G.

6. Many Formations in Illinois have Oil Possibilities. T. P. Sanders. *Oil & Gas J.*, 3.12.36, **35** (29), 40–41.—The main sedimentary basins of Illinois and S.W. Indiana are separated from the Kentucky Basin to the south by the Rough Creek fault zone. These three basins together form the Eastern Interior Coal Basin. The La Salle Anticline lies on the eastern edge of the Illinois Basin and can be traced in an approximate N.–S. direction for 240 miles. The eastern flank of this structure dips at a more gentle angle than the western, although the sediments east of the anticlinal axis are thinner and cover a much smaller area than on the other side. The South-west Illinois field, on the southern end of the La Salle Anticline, is ranked the fourth largest field in the United States, and produces from lenticular sands in the Lower Pennsylvanian and the Chester and Big Lime of the Mississippian.

A well drilled to test the possibilities of deep production found oil shows at the base of the Mississippi Lime and the top of the Niagara Limestone. The Trenton was met at 4243 ft., but the well did not go much deeper, and the St. Peters Sandstone and lower strata were not tested.

It is estimated that oil recovery from known producing horizons in this field averages only 10–15%. This figure may not be accurate, but it indicates that repressuring or water-flooding might result in the recovery of another 400,000,000 brls. of oil in addition to the 411,265,000 brls. already produced. J. A. G.

7. Economic Importance of the Sabine Uplift. H. D. Easton. *Oil & Gas J.*, 26.11.36, **35** (28), 23, 24, 34.—The stratigraphy of this area is characterized by the large number of important unconformities. No Pennsylvanian beds have been found underlying the Sabine Uplift, but deeper drilling may prove them to be present in places. The Permian is represented by a thick salt and anhydrite mass capped by a limestone (Big Lime). The latter is productive at Smackover, and the age of the upper portion is still uncertain. It is difficult to state the age of any formation immediately overlying the Permian, because a major unconformity is present which eliminates most, if not all, of the Jurassic, Triassic and part of the Permian. It is not unlikely that remnants of these formations are present on some parts of the Uplift. The Lower Cretaceous is represented by the Travis Peak, Glen Rose, Paluxy, Fredericksburg and Washita. Of these the Glen Rose is the most important producer, but recent drilling has proved the presence of oil in the Travis Peak, and it is hoped to extend the production from sand bodies in this formation. In some areas a triple unconformity eliminates the Washita, Fredericksburg and Upper Glen Rose. This is the case at Pine Island and Bellevue. The Upper Cretaceous consists of the Woodbine and Blossom Sands, a chalk and marl zone (Annona Chalk and Zwolle Marl), the Nacatoch Sand, capped by a black shale and Limestone series (Arkadelphia). With the exception of the last, all these beds are productive. Another unconformity exists between the Tertiary and the Upper Cretaceous. The Tertiary is represented by the Midway (black shale), Wilcox (sands and lignite), Claiborne (sands and limestone with oil at the base) and the Jackson (shale and limestone, also with oil at the base).

One of the most important areas yet to be tested lies on the southern end of the Uplift, where several salt domes have been discovered, and production may be obtained from the Glen Rose and Travis Peak if they occur around the edges of the domes.
J. A. G.

8. Montana Has Many Promising Oil Areas. L. G. E. Bignell. *Oil & Gas J.*, 3.12.36, **35** (29), 23, 25.—The Cut Bank field is the largest in this general region, and is located on the western flank of the Sweetgrass Arch in N.W. Montana. The Triassic, Permian and Pennsylvanian are entirely missing over this structure, which was probably formed in late Cretaceous times. The geology of the field has not been thoroughly worked out, but it is almost certain that many of the producing sands are lenticular and probably represent shore-line deposits. They range in age from Lower Cretaceous to Mississippian.

The Kelvin-Sunburst field, a few miles to the east, produces from the Sunburst Sand (Lower Cretaceous) at about 1500 ft., and the Ellis Sand (Mississippian) at 1800 ft. South of this area lies the Pondera field, which produces from the Madison Limestone at 2000 ft.

In S.E. Montana the Baker-Glendive structure is being developed. It is almost 80 miles in length, and one well has found showings of oil at 6698 ft. in what is thought to be the Madison Limestone. The well was deepened to 8300 ft. and a second oil show was reported, the age of which has not yet been determined. J. A. G.

9. Six Sands Found Production in the Knobs District, Western Kentucky. T. P. Sanders. *Oil & Gas J.*, 3.12.36, **35** (29), 27.—The Knobs field lies about 5 miles S.W. of the town of Livermore, but is unconnected with Livermore field, although both produce from the same horizons. In the Knobs field oil and gas are first found in an unnamed sand at 400 ft. The Big Water sand, a prolific gas horizon, is encountered at about 765 ft. Both are Pennsylvanian in age. At 1450 ft. the Jett Sand (Mississippian) is also a gas sand. The Jackson Sand (1550 ft.), the Barlow Sand (1650 ft.) and the Bethel Sand (1775 ft.) are all oil horizons in the Mississippian.

The formations below the Bethel Sand are almost completely untested, and it is reasonable to hope that the St. Peters Sandstone and Corniferous Lime will prove productive.

The field lies in the Rough Creek fault zone, which separates the Kentucky Basin from the Illinois Basin, and is probably located on a horst block within this zone. No evidence of faulting has been discovered within the block. J. A. G.

10. Permian and Pennsylvanian Sediments Exposed in Central and West Central Oklahoma. D. A. Green. *Bull. Amer. Assoc. Petr. Geol.*, 1936, **20**, 1454–1475.—The sediments exposed in Central Oklahoma are mainly local in type, due to unconformities, lenticularity, gradation, etc. They may be divided as follows: Belle City limestone, shales and sandstones, Vamoosa formation, Pawhuska limestone, Pontotoc terrane (contact between Pennsylvanian and Permian here), Garber-Wellington section, Hennessy shale, Duncan sandstone, Blaine formation, Dog Creek formation, Marlow formation, Rush Springs formation, Quartermaster formation (Up. Permian). These divisions are described and defined. The danger of using the colour of the beds to delimit formations is pointed out, the colour changes not coinciding with stratigraphical changes. S. E. C.

11. Stratigraphy of Arkansas–Oklahoma Coal Basin. T. A. Hendricks, C. H. Dane, and M. M. Knechtel. *Bull. Amer. Assoc. Petr. Geol.*, 1936, **20**, 1342–1356.—The Arkansas–Oklahoma coal basin lies south of the Ozark–Boston Mountain uplift and north of the Ouachita uplift. The formations present are of Mid. Pennsylvanian age, and are, in order of deposition, the Atoka formation, the Hartshorne sandstone, the McAlester shale, the Savanna sandstone and the Boggy shale. They all decrease in thickness westwards and northwards. There are several probable sources for the sediments: Llanoria, the Ouachita mountains, the Arbuckle mountains and an uplift which may have been near the present position of the Black Knob Ridge. Considerable evidence of structural movements in the basin has been obtained. The Arbuckle mountains uplift extended into the basin at several periods, and there was progressive sinking of the basin in the south. It is unlikely, however, that any single movement affected the whole of the basin. S. E. C.

12. Dawson and Laramie Formations in the S.E. Part of the Denver Basin, Colorado. C. H. Dane and W. G. Pierce. *Bull. Amer. Assoc. Petr. Geol.*, 1936, **20**, 1308–1328.—The recently published map of Colorado shows a greater extent of Dawson arkose than previous maps. In this paper the evidence on which the Laramie–Dawson junction is based and the nature of those formations are briefly reviewed. S. E. C.

13. Ordovician Fossils from the Type Section of the Deadwood Formation, S. Dakota. W. M. Furnish, E. J. Barragy, and A. K. Millar. *Bull. Amer. Assoc. Petr. Geol.*, 1936, **20**, 1329–1341.—The Deadwood formation—Up. Cambrian—has been considered to include the shale and siltstone above the Scolithus sandstone. Palæontological evidence is now advanced to show that these strata belong to the Whitewood formation (Ordovician). Diagnostic fossils were not obtained from the Scolithus sandstone and underlying strata, so that the Cambrian–Ordovician junction could not be fixed.

S. E. C.

14. Geology of the West Margin of the Argentine Chaco. B. Wellhofer. *Z. Deutsch Geol. Ges.*, 1936, **88**, 557–564.—The Lomas de Olmedo and the sierras Santa Barbara, Centinela, La Ronda and del Maiz Gordo form a region which is bounded on the east by the Chaco of the province of Salta, on the south by the Rio del Valle, on the west by the Rio San Francisco, and on the north by the Rio Bermejo.

Palæozoic sediments are found only in the south, in the sierras Santa Barbara and Centinela, and are sandstones and dark, bituminous shales. These are overlain unconformably by sandstones of a continental type, which probably correspond to the lower part of Steinmann's " Puca " formation. In the north these sandstones—the " Areniscas Inferiores "—rest in the Dwyka tillites, and they may be considered as upper Gondwana. They, in turn, are overlain by a series of red sandstones and calcareous sandstones, followed by oolitic and sandy limestones and dolomites. The age of this series is very doubtful, it being placed in various positions from the Trias to the Cretaceous by different investigators. The geological activity in connection with the Salta and Jujuy oilfields should throw some light on the problem. Next in succession are the green marls, and then follow the " Areniscas Superiores," probably unconformably. This upper sandstone series consists of conglomerates, clays and marls with intercalations of sandstones, tuffs and limestones. It is probably Cretaceous, but an exact determination has not yet been made. The Tertiary is represented principally by marly and variegated sandstones, with clay and marl intercalations, and corresponds with Bonarellie's " Terciario subandino." At various places this is overlain unconformably by the Jujuy beds.

The first orogenic movements that can be distinguished took place in the period between the Devonian and the Permian. The effect of this folding has been largely masked by the later tangential thrust of the Andine movement. This resulted in complicated folding and overthrusting. It is suggested that structures similar to those found in the Alberta fields may occur. Occasional seepages are found. The most important is the Laguna de la Brea, where the oil rises to the surface along a fault or thrust plane. Wildcat wells near by were dry, but a well located on an anticlinal structure to the north reached oil. Other wells are located near this, and also near the Laguna Taguaipi at the south end of the Lomas de Olmedo. The results obtained are not known to the author.

S. E. C.

15. Summary Digest of Geology of Trinidad. H. G. Kugler. *Bull. Amer. Assoc. Petr. Geol.*, 1936, **20**, 1439–1453.—The present paper both summarizes and brings up to date Lehner's paper which was published in 1935. A concise account of the stratigraphy is given, emphasis being laid on the need for a standard terminology for the recognized formations. The present multiplicity of names for the same formation only makes for confusion in an area where there are extraordinarily rapid lateral changes in most beds. Accurate correlation is of importance not only for the solution of problems in Trinidad, but also in E. Venezuela, where the structure is covered by Pleistocene and Quaternary sediments.

A number of comments on structural conditions serve as an appendix to Lehner's account.

The best prospect for the discovery of new fields lies in the stratigraphical accumulation of oil. The La Carriere shale (Lr. Cretaceous) and the Argiline mudstone beds (Cret.–Eocene) are good source rocks in addition to the bituminous Tertiary marl.

S. E. C.

16. Possibility of Oil and Gas Production from Palæozoic Formations in Europe. W. A. J. M. van Waterschoot van der Gracht. *Bull. Amer. Assoc. Petr. Geol.*, 1936, **20**, 1476–1493.—Palæozoic rocks supply a considerable part of the production in North America, whereas in Europe their yield is very small. A review of the characteristics of source rocks and reservoir rocks shows that the European Palæozoic is as favourably situated as the North American in that respect. The main difference lies in the depth of burial; in N. Europe, especially the Dutch and German plains, the Palæozoic is very deeply buried, and thereby obscured. Its structure is therefore a matter of conjecture. Probably the extension of the Fennoscandian shield is covered by a gently warped and faulted sequence of Palæozoic rocks. The Variscan folding disappears to the north, but there is a complication due to the Mesozoic–Tertiary Saxonian folding. The author, in contrast to Stille, believes that the older Caledonian folding did not affect this area.

The general absence of oil within the area of Palæozoic outcrops may be ascribed to the regional metamorphism due to the intense folding in that zone. The search for Palæozoic oil should therefore move away from these outcrops on to the foreland, and it is necessary to find areas which, while sufficiently removed from the strongly folded zones, are still not too deeply buried to be reached by the drill. Such areas are to be found in Westphalia and in the Belgian Campine. Deep drilling has already started. Four wells are being drilled in Westphalia, near Ascheberg, Kiltrup and Oelde, and one in the Belgian Campine, near Moll, in order to test these Palæozoic possibilities. The location of these wells was assisted by the results obtained from borings made for coal earlier in the century. S. E. C.

17. Oil in Asia Minor. B. Granigg. *Z. Prak. Geol.*, 1936, **44** (7), 101–104.—Two separate regions are considered: the outer margin of the Taurus mountains and E. Anatolia.

The geology of the country between Mardin in the west and the Tigris in the east is briefly described. The first Turkish test well was drilled on a dome in the Eocene limestone in Ba-Sebrin on the Midyat plateau. Shows of asphalt are found in the Up. Cretaceous in the Kerços anticline. Other oil and asphalt shows are known around Kerços. The fires of Yanar-Tas at Cirali on the Mediterranean, 58 km. S.S.W. of Antalya, probably derive their gas from the Cretaceous. The gas escapes through cracks in a serpentine intrusion in an eroded anticline of Eocene limestone. These fires were burning in pre-Hellenic times.

Seepages are found in the county between Erzerum and Lake Van. Structurally, however, this district is not promising, and the seepages are associated with faults. Westwards from Erzerum the tightly-folded structures open fan-wise, and this area may be more promising. No seepages are known there, and detailed geological evidence is lacking. Short notes are given on the seepages at Cemagil, Palk, Hasan-Kale, Katranli, Divani-Husein and Neftik, Ercis and Boyabat. S. E. C.

18. Search for Oil in Müreffe, Turkey. Cevat Eyüb Taşman. *Bull. Amer. Assoc. Petr. Geol.*, 1936, **20**, 1372–1373.—Müreft is on the European shore of the Marmora, 81 miles from Istanbul. Four shallow wells were drilled near Hoşköy during the summer of 1935. These were located near an old well said to have produced oil. Two of these wells gave shows, but all encountered abundant salt water. A new well commenced in April 1936 gave strong flows of wet gas at a depth of 126 m., but on deepening the well to 150 m. brackish water was obtained.

The structural conditions in front of the overthrust block of Mt. Elie are obscured by landslides, but some minor folds can be distinguished. The area is overlain by Miocene sands, marls and shales, and oil in these has been observed at Isterne Dere and elsewhere. S. E. C.

19. Development of Porosity in Limestones. W. V. Howard and M. W. David. *Bull. Amer. Assoc. Petr. Geol.*, 1936, **20**, 1389–1412.—Limestone reservoirs are of two main types: limestones, either strongly or not strongly jointed, with secondary porosity

due to solution, and jointed limestones without secondary porosity. 95% of the known reservoirs are of the first type.

As a result of experiments, it was shown that solution is mainly due to organic acids produced by bacterial action on organic matter and to the CO_2 then evolved. The factors affecting solution are jointing and fracturing, bedding planes, and the nature and arrangement of the grains which form the rock. Jointing and fracturing cannot be examined in the laboratory, but the relative importance of the other factors can be determined after suitable treatment of specimens. These were deeply etched with hydrochloric acid and then treated with potassium ferricyanide. The ferricyanide stains dolomite blue when a small quantity of ferrous carbonate is present in the latter.

Various patterns are produced by etching, and they fall into three groups: equi-solution type, channel type and cellular type. The equi-solution type is characterized by very even solution, and therefore the effect of weathering on a rock giving such a pattern would be a general widening of fractures and joints. A channel pattern is produced in heterogeneous limestones as a result of the unequal rate of solution of calcite and dolomite. The channels formed may be the result of solution of calcite grains arranged in chains or the solution of secondary calcite from old channels. A cellular pattern is characterized by a pitted surface, and is due to the presence of scattered soluble grains in a less soluble matrix.

The effect of the presence of secondary calcite and of insoluble residues on the efficiency of acid treatment of limestone reservoirs is also discussed. S. E. C.

20. Aerial Maps, Greatly Improved, Simplify Work of Geologist and Engineer. G. S. Rice, jr., and J. C. Atkinson. *Min. & Met.*, 1936, **17**, 569–572.—About 9 years ago the great oil territory of south-west U.S.A. started its aerial photographic mapping. The first results were unsatisfactory because of scale inaccuracy and other control features limiting its effective use. The collaboration of mapping companies with five big oil companies has since then evolved a technique which, with improvements in equipment, has resulted in clearer and more uniform photographs and, particularly in importance and value, in obtaining scale accuracy and all other control features. Practically the whole south-western area has now been aerially mapped. The main cause of such accuracy being obtained lies in the division of the area to be mapped photographically into units, called grids, geodetically controlled polyconic projections of 7½ minutes of latitude and longitude, which in the Texas latitude average 65 sq. miles. After the films are developed and printed, they can be arranged in a grid mosaic, the accurate scale of which is then determined. Each grid will then agree closely with the U.S. Government and State triangulations and all other available controls. These aerial photographic maps are of great use and value in time saving, in saving of expense and in greater accuracy and thoroughness of work, not only on the geophysical and geological side, but also on the legal and ground acquisition aspect of oilfield development and to the engineering department as well, as detailed by the authors. B. F. N. M.

21. Quantitative Determination of the Connate-water Content of Oil Sands. H. C. Pyle and P. H. Jones. *Oil Weekly*, 16.11.36, **83** (10), 46–52.—In order to determine the connate-water content of cores, dextrose was added to the drilling mud as a tracer, and after thorough mixing and circulation a core was taken. As soon as the core was withdrawn it was sampled, and the specimens were carefully preserved. In the laboratory the contents of oil and water were determined by distillation. The porosity was measured on adjacent samples, and in a third portion the dextrose content was found by the copper reduction method.

The results show no simple relationship between sand texture, oil and connate-water content and degree of contamination in coring. Samples of oil sands from the core barrel showed relatively large water contents. On an average 29% of the water came from the drilling mud. The rest was connate. From these figures the space in the core available for oil and gas was calculated. On an average connate water filled 38% of the pore space. Oil occupied about half of the remaining pore space, and

gas filled the rest. These figures assume that gas expansion occurring as the cores were taken from the well did not cause loss of fluid, and the cores are reported to have shown no signs of such action. G. D. H.

Geophysics.

22. New Geophysical Method Provides Reliable Data for Structure Mapping. W. A. Sawdon. *Petr. Eng.*, Oct. 1936, **8** (1), 25.—A new method of geophysical surveying that segregates the reflected waves and permits their proper identification has been developed by the Rieber Laboratory and has been named the geo-sonograph method. This method utilizes the discharge of a shot at one point and picks up the reflected waves at given points, but the accumulation, presentation and interpretation of data are different from the ordinary seismograph method. In this method ten receptors pick up the wave impulses which are photographed on a 35-mm. film in the form of ten sound tracks. This film is run through a specially designed apparatus that sums up the wave impulses and records them in a clearly defined line. This eliminates any possible errors due to the human element. L. V. W. C.

23. Electrical Logging Technique as Applied to Petroleum Production. L. W. Storm and R. T. Wade. *Petr. Eng.*, Nov. 1936, **8** (2), 66–76.—In addition to their great value to geologists in working out structure and sedimentary changes, the Schlumberger methods and processes are of great help to the petroleum engineer and production manager. The equipment and technique are applied with great value to: (1) The completion of wells; (2) reconditioning wells to shut off water; (3) reconditioning wells to exclude gas; (4) evaluating the sands, calculating reserves, estimating potentials, etc.; (5) checking casing depths, locating junk in a well, ascertaining distribution of cement behind casing.

This article outlines the application of the Schlumberger technique to each of these five phases of everyday field work, giving instances from several wells in different fields in the U.S.A. and Venezuela of the results obtained. These are illustrated by 12 figures of diagrams, etc. A bibliography of the publications on the subject is given. B. F. N. M.

24. New Portability in Seismic Instruments. Anon. *Oil Weekly*, 7.12.36, **83** (13), 30, 34.—A large proportion of the areas with favourable trends on the Texas Louisiana Gulf Coast is covered by timbered swamps, dense thickets and marshy lakes, a condition which has precluded reflection seismograph work, because of inaccessibility to such areas with the old-style large equipment. A new portable oscillograph (Reflection-Seismograph) weighing less than 100 lb. has recently been introduced, which is claimed to have all the essentials of the heavier instruments in a lighter and miniature form. The whole outfit can be carried by four men on foot as contrasted with crews of 16 to 25 men and 10 to 12 vehicles required for the older equipment. The past five years have shown an immense increase in reflection seismograph work on the Gulf Coast. The big oil companies were practically alone in the adoption of this prospecting method up to 1932, but their successful results have now led individuals and smaller companies to invest some of their exploratory capital in work by reliable reflection seismograph companies. The progress of seismography on the Gulf Coast is shown by the progressive figures for crews operating in the past five years: 1932, 10 crews; 1933, 31; 1934, 42; 1935, 54; and 1936, 66. The progressive changes in the technique are discussed, and it is asserted that a large portion of the open Gulf Coast areas has now been worked over, and even the open water areas are rapidly being exhausted, so that now there is left very little to do outside of the difficult swampy territory, for which the portable instrument was specially developed. B. F. N. M.

Drilling.

25. Casing Cemented at Top and Bottom in One Operation. R. M. Cook. *Petr. Eng.*, Oct. 1936, **8** (1), 32.—As a means of cementing off all surface formations and at the same time cementing 8¾ in. casing as a water string, it was decided to place cement in two batches, one around the shoe and the other from about 1000 ft. down to the surface.

The 8¾-in. casing was run in with a Baker float shoe and 450 sacks of cement were pumped in under a final pressure of 600 lb. The pressure was released to check the back-pressure valve in the float shoe. This was found to be working perfectly.

A Lane-Wells gun perforator was run and 10 holes shot at 1050 ft. After circulation had been obtained 400 sacks of cement were run with a final pressure of 300 lb. When the cement reached the surface the upper plug was stopped to ensure that the cement would seal off the holes in the pipe. L. V. W. C.

26. Drilling Mud and Heaving Shale. K. H. Clough. *Petr. Eng.*, Oct. 1936, **8** (1), 43.—It has been shown previously that a mud of low viscosity can be disadvantageous from two standpoints: first, when it is necessary to stop circulation, and secondly when circulation is lost or impaired.

In the second case the circulation is lost through the removal of the mud and suspensoids. The colloidal material present in the mud will pass into the formation in its colloidal form. Where the formation encountered is of an extremely porous nature and the mud contains little or no colloidal material, returns will decline appreciably as soon as the formation is penetrated.

As a result of this decline the resultant linear velocity of the mud upward in the well first equals the settling rate of the suspensoidal particles. Sticking of the stem and bit may follow, but the faults of the mud can be remedied by increasing the colloidal content. Several methods for accomplishing this are available.

Heaving shales are causing more trouble than any other formations, and the present practice in combating this is to use drilling muds of light weight and of high viscosity with a relatively high *p*H and with as little free water as possible.

The addition of salt solutions to the water in which the heaving shale is dissolved with bentonitic materials has been found to reduce the swelling.

Continued experimentation is being carried on, and this is necessary in view of the fact that as wells are being drilled to greater depths the problem is becoming more complicated. L. V. W. C.

27. Simplified Hook-up for Christmas Trees. F. B. Taylor. *Oil Weekly*, 26.10.36, **83** (7), 52.—Simplified hook-ups and cellar arrangements are being used in the Fitts Pool, Oklahoma. Flow line and valves are anchored to a clamp at the end of a nipple extending into the concrete cellar, where the nipple rests on a flanged tubing head. The 2½-in. tubing string is supported at this point. Killing of the well is possible through side gates in the tubing head. A master gate and blow-out preventer are installed during drilling. These are removed on completion and a bottom-hole choke is installed in the tubing to prevent blow-out. L. V. W. C.

28. The Hard-Facing of Oil Well Tools. E. W. Bentley. *J.I.P.T.*, 1936, **22**, 740-746.—A paper, read before the Burma branch, describing the hard-facing materials Stellite and tungsten carbide in inert, powder and composite rod forms, and their application to fish-tail and Zublin regular bits. The removal of these materials from fish-tail bits is also discussed. G. R. N.

29. Investigation of Angle Columns. S. B. Settle. *Oil Weekly*, 16.11.36, **83** (10), 33.—Records of the results of tests carried out in the laboratory on full-size angle leg sections show that there is a discrepancy in the existing A.P.I. column formulæ.

The article points to the need of further investigation for the purpose of evolving a more correct method of rating derricks so that the safe load capacities of the derricks will be commensurate with the strength of the leg sections. L. V. W. C.

30. Diesel Engine Hook-ups on Texas Rotary Rigs. Anon. *Petr. Eng.*, Oct. 1936, **8** (1), 100.—Twin diesel engines have been ingeniously hooked up, enabling each engine to work on a separate job or to be engaged by means of a clutch to throw the full power of both engines to one task. This outfit drills a 4000–4500 ft. well on 1000 to 1200 gal. of diesel fuel. L. V. W. C.

31. Small Rig Powered by Automobile Engine. F. B. Taylor. *Oil Weekly*, 9.11.36, **83** (9), 87.—Unusually fast drilling time has been made with the arrangement being used in the shallow area of N.E. Oklahoma. Here a contractor has installed a car motor to power drilling equipment. The rig is of the portable type and the engine has been converted to operate on gas. High pulling speeds have been reached; in one case a string of tools consisting of a jar, a 20-ft. stem on an 8-in. by 8-ft. bit was pulled from a depth of 1068 ft. in one minute twenty-four seconds. Over a period of 58 hours of operation from 560 to 1060 ft., 8·6 ft. of hole were made each hour. L. V. W. C.

32. Water Softening with Lime and Soda Wash. H. Bottomley. *Refiner*, 1936, **15**, 416–418.—An article intended for the small plant operator of oilfield steam-generating units, giving simple calculations and the minimum analytical tests to enable him to properly soften the raw water available. G. R. N.

33. Patents on Drilling and Production Apparatus. G. T. Horton and C. L. Day. U.S.P. 2,057,682, 20.10.36. Oil storage tank of cylindrical form with a vertically movable roof and means for sealing the space between the roof and the shell.

F. Wilcom. U.S.P. 2,057,754, 20.10.36. A combination cup and plunger oil-well pump.

D. B. Munroe. U.S.P. 2,057,787, 20.10.36. An oil-well surveying instrument consisting of a combination of a laterally extending shaft, a slidable target support, and a lever secured to and projecting from the shaft. A connecting-rod connects the lever with the target support, and means are provided for rotating the shaft to cause the connecting-rod to axially reciprocate the target support to and from a marking position. Means for releasing the lever at any time are also provided.

F. A. Thabeld. U.S.P. 2,057,859, 20.10.36. Oil well swab.

B. E. Parrish. U.S.P. 2,057,966, 20.10.36. Oil well swab.

J. G. Dyer. U.S.P. 2,058,069, 20.10.36. An oil well-cementing assembly consisting of a casing head with a plug and means for positioning the plug in the head. A stop is arranged to limit the upward movement of the plug and an inlet immediately below the plug permits cement to be pumped into the well. Above the plug there is an inlet for mud and a measuring line carrying a weight is provided for determining the depth at which the plug stops.

J. T. Phipps. U.S.P. 2,058,103, 20.10.36. Circulation packer.

O. J. Williams. U.S.P. 2,058,119, 20.10.36. Formation tester and core taking device.

J. H. Howard and A. C. Catland. U.S.P. 2,058,154, 2,058,155 and 2,058,156, 20.10.36. Core drill head.

I. J. McCullough. U.S.P. 2,058,166, 20.10.36. Jarring tool.

J. D. Spalding. U.S.P. 2,058,186 and 2,058,187, 20.10.36. Spring hook.

A. Anderson. U.S.P. 2,058,286 and 2,058,287, 20.10.36. Apparatus for surveying bore-holes, consisting of an electro-responsive recording device together with a source of energy for operating this device and operating means.

E. K. Lane. U.S.P. 2,058,327, 20.10.36. A whipstock that can be dropped to the bottom of the hole freely and which includes a cylindrical body made up of frangible material to be cut away by the drill.

H. C. Long. U.S.P. 2,058,331, 20.10.36. Sucker-rod guide paraffin cutter.

C. E. Reed. U.S.P. 2,058,624, 2,058,625, 2,058,626, 2,058,627, 2,058,628, and 2,058,629, 27.10.36. Roller cutter bit, disc bit and reamer.

W. F. Hall and G. A. Lowrey. U.S.P. 2,058,687, 27.10.36. Pipe puller.

E. P. Halliburton. U.S.P. 2,058,688, 27.10.36. An apparatus for plugging-off wells.

D. Rallet and F. Keller. U.S.P. 2,058,825, 27.10.36. A deparaffinator consisting of a reciprocating element capable of being driven up and down the tubing by fluid pressure. Shock absorbers are placed so that the reciprocating element may be stopped at the ends of its travel.

R. L. Chenault. U.S.P. 2,059,508, 3.11.36. A deep-well pump comprising a tubing string with a displacement chamber, a source of pneumatic pressure and reciprocable eduction pipe. A valve is operated by the reciprocation of the eduction pipe for alternately admitting liquid from the well to the displacement chamber while this is being vented. This liquid is dispelled from the chamber by pneumatic pressure.

E. S. Sloan. U.S.P. 2,059,538, 3.11.36. Hydrostatic sand pump.

J. F. Stephan. U.S.P. 2,059,540, 3.11.36. Rotary jar.

V. F. Ehrgott. U.S.P. 2,059,566, 3.11.36. A well-cleaning device consisting of a low-pressure chamber with an inlet having a movable closure for this inlet and the closure carrying a cylinder. A piston is carried by the body of the tool and enters the cylinder bore.

J. J. Santiago. U.S.P. 2,059,611, 3.11.36. A well-cleaning device having a low-pressure chamber maintained closed against the high pressure in the well until a predetermined time.

W. C. Erwin and C. H. Sweet. U.S.P. 2,059,627 and 2,059,628, 3.11.36. Well-cleaning device and means of control.

W. C. Erwin and C. H. Sweet. U.S.P. 2,059,629, 3.11.36. Well bailer.

W. C. Erwin. U.S.P. 2,059,630 and 2,059,631, 3.11.36. Well-cleaning device.

B. E. Parrish. U.S.P. 2,059,901, 3.11.36. Well packer.

F. E. Fairfield. U.S.P. 2,059,939, 3.11.36. Self-cleaning well liner.

L. V. W. C.

Production.

34. Diminishing Allowables per Well. W. E. Hubbard. *Oil Weekly*, 26.10.36, **83** (7), 36.—In three years in Texas the average daily allowable per well has decreased by about 53% and a critical point has been reached in which the production of each new well adversely affects the allowable of wells already completed. Suggestions are made by the author as to equitable schemes to solve the problem of proration.

L. V. W. C.

35. Preliminary Investigation of Flowing Wells. E. Kemler and G. A. Poole. *Oil Weekly*, 23.11.36, **83** (11), 31.—A study of the possibilities for increasing the flowing life of wells and for the more accurate control of bottom-hole pressures and gas-oil ratios by proper tubing design is desirable if the low cost of producing oil from flowing wells is to be maintained.

The general problem is discussed and the results of a preliminary investigation of flowing wells in the West Texas area are given. A newly-developed recording bottom-hole pressure-gauge was used in the tests for determining the flow pressures.

Formulæ for calculating well characteristics are treated.

The use of the well potential in the determination of the allowable production makes a knowledge of the behaviour of a well important in the economic recovery of oil. The potential of a flowing well may be increased by reducing resistance in the discharge line to a minimum and to select the proper tubing proportions to make the pressure drop in the tubing a minimum. A minimum pressure on the face of the sand is given by this combination.

L. V. W. C.

36. Flow of Heterogeneous Fluids through Porous Media. M. Muskat and M. W. Meres. *Physics*, 1936, **7**, 346–363.—This paper is based on the empirical data established by R. D. Wyckoff and H. G. Botset on the flow of gas–liquid mixtures through unconsolidated sands (Abs. 1431, 1936). Applying the equations formulated in their paper, experiments show that the properties of flow systems of heterogeneous fluids differ very slightly from the corresponding ones for homogeneous fluids, provided the pressure exceeds about half the saturation pressure of the gas, except that the liquid saturation is very closely equal to the equilibrium value and the liquid permeability value is almost that of its equilibrium. At the outflow surfaces, and in regions of pressure very much less than saturation pressure, the drop in liquid permeability and saturation is highly localized, and the increase in the pressure gradients above their normal homogeneous fluid values is largely confined to those regions. An analytical theory was derived, based on taking the transient type of flow as a continuous steady succession of steady states, whereby the early stages of transient types of flow were studied. For the investigation of the complete history of the linear transient system, a numerical method is given. Experiment was made with a linear column of sand of unit length, filled with liquid saturated with an ideal gas to a pressure of 10 units. This was suddenly exposed at one terminal to a pressure of but one unit permanently maintained whilst the other end was permanently kept closed. Resulting calculations are graphically given by sets of curves for saturation and pressure distributions within the flow channel, the time variation of the flux from the system and the time variation of the gas–liquid ratio associated with the liquid efflux. It was shown that the liquid saturation at the time the system was depleted, corresponding to an equalization of the pressure to that maintained at the outflow terminal, is quite uniform, being only 5% less at the outflow terminal than at the closed terminal of the linear column. The gas–liquid ratio was found to increase monotonically with the time.

The authors then discuss the value of these conclusions to such problems as well spacing, gas recycling in underground oil reservoirs and the manner of treatment of other typical heterogeneous fluid systems so as to include both the deviations from the ideal behaviour of the free-gas phase and the effect of gas segregation.

B. F. N. M.

37. Maintenance of Field Gas Testing Equipment. F. B. Taylor. *Oil Weekly*, 9.11.36, **83** (9), 51.—The measurement of natural gas volumes is based on factors obtained through tests made in producing sectors as well as along the line. Accuracy is dependent on the care exercised in maintaining the equipment, and the chief instrument in obtaining corrective factors for orifice meter calculation is the gravity balance. This balance enables the weight of a given sample of gas to be compared with a like quantity of air under similar conditions. The balance should be checked for leakage if it is not in fairly constant use. Leaks at valve bases should be soldered and reseated and manometers used with specific gravity equipment must be cleaned frequently, as the mercury amalgamates with a number of elements and then has a tendency to cling to the sides.

Various other recommendations for handling gas-testing equipment are made.

L. V. W. C.

38. Integration Errors in the Measurement of Gas Flows through an Orifice. H. Gilmour. *J.I.P.T.*, 1936, **22**, 747–753.—A paper, read before the Burma branch, demonstrating mathematically the errors incurred by employing a square-root planimeter in the computation of flow charts for compressible fluids. G. R. N.

39. Pumping Fluid with Least Possible Expense. D. E. Schnobrich. *Oil Weekly*, 23.11.36, **83** (11), 25.—Some of the important advances made in handling oil-well pumps are described. Pumping economies have been realized by operators of shallow wells by the adoption of a new re-boring cycle for standard plunger liner pumps with metal-to-metal seal. In addition, operating difficulties have been materially reduced by changes in the method of handling such equipment.

L. V. W. C.

40. The Sucker-Rod Pump as a Problem in Elasticity. J. F. Kendrick and P. D. Cornelius. *Oil & Gas J.*, 22.10.36, **35** (23), 50.—Three factors must be considered when dealing with the motion of sucker-rod pumps. First, the motion of the pumping unit; secondly, the natural vibration of the system, and thirdly, the frictional factor. A simple example can be obtained by the use of elastic bands with a weight at the lower end, the motion being made inside a glass tube representing the tubing string. The mathematics of the case are given and the conclusions stated that the size of plunger is limited by the allowable unit sucker-rod stress, that the strokes per minute are limited by the allowable ratio of the period of the natural vibration to the period of the forced vibration. A polished rod stroke that will give the required plunger velocity without exceeding the strokes per minute set by the critical ratio of the period of natural vibration and forced vibration should be used. L. V. W. C.

41. The Performance, etc., of Direct Gas-Actuated Plunger Units. G. A. Walling. *J.I.P.T.*, 1936, **22**, 727–739.—A lecture, with discussion, held at the Trinidad branch, on the scope and performance of several plunger lifts under various field conditions employing a unique method of utilizing available formational energy. Lifting costs are given. G. R. N.

42. Gas Lift Operations. S. F. Shaw. *Oil Weekly*, 9.11.36, **83** (9), 66.—The Cary lease is one of the principal leases in the Oklahoma City field, and all its wells have been produced by natural flow and gas lift or a combination gas-lift pumping method.

This area illustrates how a large quantity of oil can be produced from such wells after several years of productive life where conditions are suitable. Although these wells are deep, the costs of operation are low, and even with low bottom-hole pressures the production is large. In addition, the bottom-hole pressures have remained practically unchanged for more than six months even though all the offset wells are producing at a fair rate and the spacing is less than 5 acres per well in the general vicinity. L. V. W. C.

43. North-east Oklahoma Water Flood Projects. F. B. Taylor. *Oil Weekly*, 2.11.36, **83** (8), 19.—Some of the old wells in the north-east district of Oklahoma which had been used as air injection wells were reamed and shot and equipped with new casing. Water was then injected, and the first show of production gave basic sediment, sludge and molecular carbon in suspension. This continued for ten months before pipe-line oil was produced. L. V. W. C.

44. Texas Water-Flood Project. J. C. Albright. *Oil Weekly*, 26.10.36, **83** (7), 19.—Considerable attention has been paid to the possibilities of successfully procuring increased ultimate recoveries by water flooding in mid-Continent fields. It is too early yet to know the final recoveries, but several projects indicate excellent possibilities. This article discusses the project in the Oscar Farish Survey, comprising 144 acres. Input wells are drilled in the manner usually used for producing wells, being cased to the bottom with a shoe in the sand instead of in the shale above. This string is cemented. The water used is treated prior to injection. L. V. W. C.

45. Water-Flood Drive. F. Swindell. *Oil Weekly*, 9.11.36, **83** (9), 54.—A water flood project which differs widely from the work done elsewhere has recently been initiated in Wagoner County, Oklahoma. This project is directed towards increased recovery from a shoestring lense type of accumulation, and involves two fundamental principles, (1) to flush out the remaining recoverable oil slowly and at a uniform rate and (2) to obtain this oil at a minimum of expense.

The source of the input water is a water sand having an average thickness of about 100 ft. and lying about 20 ft. below the surface. Five wells were drilled and are producing from 200 to 250 brls. each.

One interesting operation is the manner in which the output wells are used as input wells. A sketch is given of this economy.

Four pumping powers are required to handle the 26 oil-producing wells and the five output wells. L. V. W. C.

46. Burning Well Located in Deep Water Put Out. Anon. *Oil Weekly*, 26.10.36, **83** (7), 30.—The Lago Petroleum Company was confronted with the problem of controlling a wild well at Lake Maracaibo, Venezuela. It was decided to drill a directional hole that would enable heavy mud to be pumped into the burning well in order to kill it. Difficulty arose because the casing strings in the burning well were being cut, and if both strings were severed the oil would flow into the water itself. A string of 24-in. protection pipe was driven over the casing strings into the lake bed. This was successful and the directional well was given time to reach the producing horizon. L. V. W. C.

47. Old Ocean Field Completed under Pressure of 3500 lb. F. L. Singleton. *Oil & Gas J.*, 22.10.36, **35** (23), 45.—Interesting operating problems were presented when the world's deepest commercial producer was completed and operated under a pressure of 3500 lb. When the hole had reached a depth of about 9960 ft. and with the hole full of 10 lb. mud, a blow-out was threatened. The blow-out preventer was immediately closed as well as the flow-line gate-valve. A swedge nipple was installed so that

pressure gauge and circulating connections could be installed. The hole bridged approximately 3000 ft. off bottom, and advantage was taken to instal a new Christmas tree having two choke outlets. All equipment used was tested to withstand a pressure of 6000 lb. Only one 500-lb. working pressure separator was installed, but this quickly froze when the high-pressure gas from the well was discharged into it. A second separator with a working pressure of 1000 lb. was then set up. Either or both of these separators can be operated separately or in series. The gas line from the first to the second separator has a by-pass, so that the gas from the high-pressure separator can be run directly to the flame. L. V. W. C.

Transport and Storage.

48. Tankage Facilities in Recently Enlarged South Texas Oil Line. M. D. Altgelt. *Oil Weekly*, 9.11.36, **83** (9), 90.—The original line laid down by the Crude Oil Pipeline Co., from Duval County, South Texas, to the deep-water terminal at Corpus Christi was not large enough to move the quantity required shortly after completion. Two alternatives only were possible: either by looping or installing additional stations. The latter method was decided upon in view of minimum expenditure required. Under the revised set-up the storage facilities have come to serve a two-fold purpose of receiving and holding for storage the crudes of various types which it is necessary to segregate and also enabling oil to be taken from the tanks to maintain continued operation in the event of a shut down at any station. L. V. W. C.

49. Balloon Vapour Saving System. J. H. Wiggins. *Nat. Petr. News*, 21.10.36, **28** (43), 25.—The history of the development of the vapour balloon is sketched in an article dealing with its construction, application and operation. As built to-day a balloon consists of a steel sheel with a fixed conical roof and a conical diaphragm, sliding within the shell. The diaphragm is fitted with counterweights and a spring to make it gas-tight. The balloon is connected by pipe-line to the tops of the storage tanks and is fitted with a vacuum/pressure relief valve operated by the movement of the diaphragm. The working pressure is 1 to 1½ in. water. Complete elimination of vapour loss is claimed, a saving which achieves the recovery of a balloon's cost in 1 to 3 years, according to the size and number of storage tanks. Since, after the balloon is in proper operation, the system is free from air, low pressures being corrected by the introduction of dry gas, the fire and explosion hazard is greatly reduced. Corrosion, too, is practically eliminated, water vapour being present in quantity insufficient to condense. H. G.

50. Electrolytic Measurement of the Corrosiveness of Soils. I. A. Denison. *Bur. Stand. J. Res.*, 1936, **17**, 363–387.—The primary purpose of this investigation was to ascertain whether the relative corrosiveness of soils towards steel could be predicted from measurements of the electrical properties of corrosion cells in which various soils constituted the electrolytes. In all, 47 soils of known corrosiveness were tested, and their properties are given in detail in Table I of the paper.

The cells consisted essentially of two steel electrodes separated by a layer of moist soil, the whole being contained in a brass ring which formed part of the external circuit. By aerating the electrodes differentially, the cell was enabled to develop its own e.m.f., and this effect was accomplished by using a steel screen as cathode while the anode consisted of a solid disc.

Measurements were first made with an applied e.m.f. and the current densities plotted against cell potentials. Then results were obtained without an applied e.m.f., the voltage, current and resistance of each cell being measured.

The losses in weight of the test specimens (the anodes) were determined, and were related to the average current density over a certain range of applied voltage, and to the total quantity of electricity produced in the corrosion process.

The corrosion of the specimens in the laboratory tests was correlated with corrosion experienced in long-time field tests.

It is concluded that the results of the tests are of value in predicting the corrosiveness of soils to iron and steel.

However, they cannot be applied to the prediction of leaks or to an estimation of the useful life of a pipe-line section until some relationship connecting depth of pitting with exposed area and time can be established. D. L. 8.

51. Cement-lined Pipe Overcomes Corrosion Trouble in Illinois Field. J. C. Albright. *Petr. Eng.*, Oct. 1936, **8** (1), 38.—The oil from the Eastern Illinois section of the Ohio Oil Company contains hydrogen sulphide, and the water produced with the oil carries a high percentage of calcium, sodium and magnesium chloride. Corrosion begins to affect the well equipment just above the working barrel, but the greatest trouble occurs in the lead lines from the wells to the lease tank batteries.

To overcome this trouble pipe called Duroline is being used. This pipe is finished with a uniform coating of cement applied to the interior under pressure. A special joint compound is employed in the collars and threads that effectively seals the threads and prevents corrosive elements from reaching this part of the pipe. L. V. W. C.

52. Bettering Pipe-line Scraper Runs. E. Sterrett. *Oil Weekly*, 23.11.36, **83** (11), 17.—Paraffin deposits in pipe-lines build up so rapidly that constant steps must be taken to keep down the accumulation to prevent overloading the pumps. Throttling the flow builds up a back pressure against which pumping can no longer be maintained.

Steaming and heating the lines on the outside is expensive, and passing the oil through the exchangers to raise its temperature is more popular.

The only positive method of clearing the line is running scrapers, "go devil" or "pigs," relying on the stream of oil being pumped to propel the mechanism and remove the loosened paraffin.

Elongation of the scraper to enable a third cup leather to be fixed has assured a packing in the line even through the longest of check bodies. L. V. W. C.

Gas.

53. Chemicals from Natural Gas. I. N. Beall. *Refiner*, 1936, **15**, 407–410.—A general account of what has been and might be achieved with the hydrocarbons present in natural gas with regard to the manufacture of industrial organic chemicals. Particular reference is made to the chlorine derivatives of methane, ethane, propane and the pentanes, the simpler monohydric alcohols, acetone, acetic acid and formaldehyde. G. R. N.

54. Chemical Transforming of Cracking Gas into Useful Liquids. R. Fussteig. *Chim. Ind.*, 1936, **53**, 1022.—It is shown that a separation can be obtained between the heavier olefines on one side and ethylene, together with the saturated hydrocarbons, on the other, using activated carbon at a temperature of 40° C. as an absorbent. The process is based on the following absorption law: the gaseous component with the lower vapour pressure displaces the absorbed gaseous component with the higher vapour pressure. The absorbed olefines and higher unsaturated hydrocarbons are driven off with steam. After elimination of the butadiene fraction by a cuprous chloride solution, the olefines are fixed individually with sulphuric acid of increasing, specific concentration, yielding the corresponding alcohols separately. P. C. K.

55. Patents on Gas. Soc. Franç. De Catalyse Généralisée. E.P. 454,806, 8.10.36. Improved enclosure for the chemical treatment in the gaseous phase by catalysis.

Studien und Verwertungsges. mit Beschränkter Haftung. E.P. 454,948, 12.10.36. Catalytic synthesis of aliphatic hydrocarbons in which the yield is increased by a two-stage process. Mixtures of CO and H_2 are partly converted catalytically at atm., or at slightly reduced or increased pressure at 180–200° C. in one stage, using less hydrogen. The condensed products are then removed and the unconverted gas is further converted. W. S. E. C.

Crude Petroleum.

56. Caustic Treatment of Crude Oil. A. V. Druzhinina and V. T. Brazhnikov. *Neft. Khoz.*, 1935, **29** (9), 47–54.—Light and heavy crude can be treated with caustic before refining properly using 10–15% of a 1–2% NaOH solution, depending on the acidity and using a temperature of 60° C. For de-emulsification used strengthened NaOH solutions may be used. This permits a 95% neutralization of the crude oil and an 85% recovery of the petroleum acids. The water content of light crude oil is increased up to 1–2% (without a settling period) and up to 4–6% in heavy crudes. The water content of both types of crude is lowered to only 1–2% on settling for 3–4 days in heated containers. To obtain comparative data, determinations of settling periods should be made in pressure vessels. Distillates from heavy crudes are practically neutral. The alkaline by-products do not yield salts of standard quality (for soap manufacture) without additional processing. An alkali treatment of oils high in water (4–6%) does not increase the water content, thus permitting the combination of alkali treatment and dehydration. For. Petr. Techn.

57. Patents on Crude Oil. G. B. Davin and M. Powell. U.S.P. 2,056,668, 6.10.36. Dehydration of crude oil emulsions by admixing them with a mixture of higher alcohols and organic acids produced by the action of micro-organisms in a fermentable solution.

M. Powell. U.S.P. 2,056,669, 6.10.36. Treatment of crude petroleum emulsions with an aqueous solution of sodium thiosulphate and a diethylene glycol ether.

I. M. Colbeth. U.S.P. 2,058,568, 27.10.36. Breaking petroleum emulsions by treatment with an unsaponified de-emulsifying agent containing an aldehyde–carboxylic acid residue.

I. M. Colbeth. U.S.P. 2,058,569–2,058,570, 27.10.36. Separating petroleum emulsions by treatment with blown castor, rape or corn oil. W. S. E. C.

Cracking.

58. Solvex Cracking Unit. Anon. *Refiner*, 1936, **15**, 392–394.—Solvex Refineries Inc. process East Texas crude in a skimming unit, plus a Dubbs cracking unit, plus a vapour recovery plant operating on the vapours from the unit under process pressure without the aid of auxiliary compressors. The Dubbs unit has a dual charged furnace for flexibility, a high-pressure and a low-pressure flash-chamber from which a fuel oil cut is taken, and a bubble tower from which one overhead and three side streams are removed. The lowest and the next lowest side streams are used as reboiler and absorption oils, respectively, in the vapour recovery plant. G. R. N.

59. Technology of the Dubrovai Cracking Unit. K. K. Dubrovai and A. V. Sheinman. *Neft. Khoz.*, 1935, **29** (12), 42–49.—Parts of the equipment, such as the combustion-cracking towers, flushing tower, filter presses for the removal of carbon black precipitated during the cracking in the oil, etc., are described and illustrated. The cycle in the

vapour-phase treating unit with $ZnCl_2$ working in connection with the cracking unit is: The pressure distillate is heated to 210–215° C. in a tube still, passed into a treating tower with eight baskets filled with pumice stone on which solid $ZnCl_2$ is precipitated, and one upper and lower basket with pumice stone coated with NaOH for the neutralization of HCl. Some of the polymers are precipitated on the bottom, and constitute a raw material for the lacquer industry, while a gasoline with an E.P. of 200° C. leaves through the top and is fractionated in a bubble tower.

For. Petr. Techn.

60. Patents on Cracking. Standard Oil Development Co. and R. K. Stratford. E.P. 456,244, 5.11.36. Cracking of hydrocarbon oils to obtain naphtha. The cracking is carried out in the presence of spent clay which has been previously used in treating a lubricating oil stock.

W. S. E. C.

Hydrogenation.

61. Patents on Hydrogenation. W. J. Tennant and Henkel et Cie. E.P. 455,086, 7.10.36. Manufacture of surface-active substances by hydrogenation of R.ArOH (R being an aliphatic residue containing at least 4 carbon atoms and Ar is an aromatic residue). The products formed are sulphonated.

International Hydrogenation Products Co., Ltd., and C. L. Brown. E.P. 455,313, 19.10.36. Hydrogenation of carbonaceous substances using as catalysts, polysulphides of metals of groups 5, 6, and 7 of the periodic system.

H. Tropsch. U.S.P. 2,057,402, 13.10.36. Destructive hydrogenation of hydrocarbonaceous substances, hydrogen being generated *in situ*. The hydrogenation reaction is effected in the presence of a sufficient quantity of calcined dolomite to catalyse the reactions and absorb the CO_2 formed from the reactions of CO and steam.

T. W. Pfirrmann. U.S.P. 2,057,971, 20.10.36. Hydrogenation of carbonaceous substances, in which water or steam is supplied to the reaction zone in a state approaching or exceeding the critical state.

P. Harold and H. Kaufmann. U.S.P. 2,058,789, 27.10.36. Destructive hydrogenation of carbonaceous substances at 300–700° C. and under 20 atm. pressure using as catalyst: silico-molybdic or silico-tungstic acid or their salts.

H. E. Potts. E.P. 455,453, 21.10.36. Production of valuable products rich in hydrogen from middle oils or high-boiling hydrocarbon mixtures—by treatment with hydrogenating gases at 420–480° C. and above 50 atm. pressure. A basic substance is employed, *e.g.* ammonia, pyridine and sulphides of molybdenum, tungsten or Rhenium are used as catalysts.

H. E. Potts. E.P. 456,371, 9.11.36. The initial material in hydrogenation processes is heated up by indirect contact with hydrogen, which is heated up to high temperatures by causing a part of the hydrogen to combine with oxygen to form water.

W. S. E. C.

Polymerization.

62. Economics of Polymerization. A. S. James. *Nat. Petr. News*, 21.10.36, **28** (43), 21.—The article deals with pertinent points arising at a refinery operators' meeting at Tulsa on 13th October. In a discussion on the smallest polymerization plant practical, it was stated that one designed to handle 600,000 cub. ft. daily was in construction.

On the question of the recovery of invested capital, it was stated that, with gasoline at 6 cents per gallon, the initial cost of a plant could be recovered in 50 days to 2 years, according to the nature of the gases treated. The smallest plant which could pay for itself in less than 3 years is one with a yield of 200–300 brls. polymer per day. This was an opinion based on a yield of 5 gallons per 1000 cub. ft. and a price for the polymer gasoline 1–1·25 cents above that of " Q " gasoline. A maintenance charge of 4% was considered adequate to cover loss due to corrosion. On the question of the sun-instability of " doctor-sweetened " gasoline, it was suggested that short contact time and rapid and complete settling were the best ways to avoid instability to sunlight. The balloon storage system was stated to be more suitable for storage tanks than for working stock tanks. Where sweet and sour storage tanks were included in the same balloon system, contamination of the sweet tanks occurred only in cold weather when it was advisable to segregate the sour tanks. H. G.

63. Polymerization and Refining of P.D. L. Gukhman, A. Degyareva and A. Nagiev. *Azerb. Neft. Khoz.*, 1935, **12**, 60–63.—The polymerization of hydrocarbons present in the pressure distillate from liquid-phase cracking is quite insignificant below 300° C. when carried out in the absence of a catalyst, and the gasoline so obtained is unstable. When using 5% " gumbrin " clay at a treating temperature of 180° C. or 3% at 225° C., a gasoline of the stability of the acid and gumbrin treated product is obtained after 20 minutes. 5% gumbrin at 225° C. yields a gasoline twice as stable as that described above. Gasolines obtained by thermopolymerization with gumbrin are more stable than those obtained in the usual gumbrin treatment in the vapour phase using the same amount of gumbrin. For. Petr. Techn.

64. Patents on Polymerization. Standard Oil Development Co. E.P. 455,114, 14.10.36. Production of polymers from olefines by treatment in the liquid phase with sulphuric acid as catalyst below −20° C.

R. C. Osterstrom. U.S.P. 2,056,978–2,056,979, 13.10.36. Polymerization of cracked gasolines by heating them in the absence of hydrogen and catalysts above 500° F. and under 600–1,000 lb./sq. in., to remove gum and colour-forming constituents.

V. Ipatieff. U.S.P. 2,057,433, 13.10.36. Conversion of normally gaseous hydrocarbons into liquid hydrocarbons by polymerization, using as catalyst a calcined mixture of pyrophosphoric acid and a siliceous material, *e.g.* kieselguhr.

V. Ipatieff and A. V. Grosse. U.S.P. 2,057,432, 13.10.36. Alkylation of hydrocarbons by allowing them to react with an olefin in the presence of aluminium bromide and benzole as catalyst.

Röhm und Haas A.-G. E.P. 455,742, 27.10.36. Polymerization of acrylic acid and its derivatives by continuous mechanical agitation in an aqueous medium in the presence of finely-divided kaolin, aluminium or ferric oxide, etc.

Standard Alcohol Co. E.P. 456,315, 6.11.36. Polymerization of hydrocarbon mixtures containing *iso*-olefins by treatment with 55–85% sulphuric acid at 50–130° C. W. S. E. C.

Refining and Refinery Plant.

65. Recovery of Nickel Catalysts. I. N. Titz and N. I. Shuikin. *Neft. Khoz.*, 1935, **29** (9), 55–57.—An Ni catalyst precipitated on Al_2O_3 and poisoned in the desulphurization of the kerosine fraction of Ishimbaev crude with hydrogen, was oxidized with O_2 at 350–400° C. and reduced with H_2 at 350–380° C., thereby regaining a considerable

part of its activity. The regeneration proceeds with greater ease with catalysts having a low content of Ni. The generation of H_2S during the desulphurization carried out in the presence of a regenerated catalyst sets in on passing a considerably smaller amount of kerosine in comparison with a freshly prepared catalyst. 5 references.
For. Petr. Techn.

66. Patents on Plant. M. J. Burkhard. U.S.P. 2,057,004, 13.10.36. Apparatus and method for the fractional distillation of hydrocarbons. W. S. E. C.

Chemistry and Physics of Petroleum.

67. Preparation of some Hydrocarbons in a Crystallized and Pure State. J. Strating and H. J. Backer. *Rec. trav. chim.*, 1936, **55**, 903.—Described are the synthesis of: *n*-Heneicosane, m.p. 40·3–40·5° C., b.p. 172–172·5° C./2·5 mm. Hg; *n*-tricosane, m.p. 46·9–47·4° C., b.p. 190–191° C./1·5 mm. Hg; methyldilaurylmethane, m.p. 28·8–29·0° C., mean mol. weight 376; 2-methyl-*n*-tricosane, m.p. 38·0–38·5° C., b.p. 207·5–208° C./3 mm. Hg; 2 : 2-dimethyl-*n*-eicosane was not obtained in a pure state, as such; 2 : 2-dimethyl-*n*-docosane, m.p. 34·55–34·75° C., b.p. 191–191·5° C./4 mm. Hg; 10-*n*-nonyl-*n*-nonadecane, m.p. — 6 to — 5·5° C., b.p. 232·5–233° C./3 mm. Hg; 1-*cyclo*hexyl-*n*-octadecane, m.p. 41·20–41·55° C., b.p. 207·5–208·5° C./3 mm. Hg.
P. C. K.

68. Structure of Aromatic Hydrocarbons in Lubricating Oil. N. I. Chernozhukov. *Neft. Khoz.*, 1935, **29** (9), 72–75.—The acyclic mono- and poly-substituents of benzene, naphthalene and diphenyl with long chains, when present among aromatics in lub. oil are of high viscosity index, resist the formation of precipitates and are stable to oxidation. Substituents of diphenylmethane, ethane, propane, etc., and probably the tricyclic aromatics which have benzene nuclei attached to carbon atoms of paraffinic chains, when present in oils, cause a lowering of V.I. and an increase in gum formation during oxidation. Oils containing acyclic derivatives from dicyclic polymerized and incompletely hydrogenated aromatics are characterized by an exceeding low V.I., low resistance to oxidation and by a precipitation of gums during the oxidation. High-quality lub. oils from Dossor and paraffinic Surakhanui and Karashukhur crudes contain aromatics mainly of the first type. Heavy crudes such as Balakhanui heavy, Kaluga and Grozny asphalt-base contain aromatics mainly of the third type. 8 references.
For. Petr. Techn.

69. Pyrolysis of Propane and the Butanes. G. Egloff, C. L. Thomas and C. B. Linn. *Ind. Eng. Chem.*, 1936, **28**, 1283.—With the improvements in experimental technique now available, it is possible to determine with greater accuracy the factors which play important parts in pyrolytic reactions. The work reported in this article supplies such data for propane between 600° and 700° C. at 1 kg. and 7 kg. per sq. cm., and also for *n*-butane at 600–650° C. and *iso*butane at 650° C. The experiments were carried out in Allegheny metal tubes. The various factors studied were: (*a*) reaction time, (*b*) temperature and (*c*) pressure. Increasing the reaction time increased the concentration of olefins in the reacted gas to a maximum, after which the concentration of olefin decreased with further reaction time. Increasing the pressure increased the reaction rate at 600° C., but at higher temperatures this effect was no longer evident. From these results it is concluded that a portion of the reaction is second-order, and its activation energy is less than the first-order reaction or reactions. Further, increase of pressure also decreased the maximum concentration of olefins in the reacted gas. Conditions for maximum yields of olefins are given in some detail. The stabilities of the hydrocarbons studied decrease in the following order: propane > *iso*butane > *n*-butane, when tested under comparable conditions. The apparent stability of these hydrocarbons is decreased considerably when subjected to pressure under certain temperature conditions.
H. E. T.

70. Mutual Solubilities of Hydrocarbons I. Freezing-point Curves of Dotriacontane in Propane and Butane. W. F. Seyer and R. Fordyce. *J.A.C.S.*, 1936, **58**, 2029–2031.—The authors have used the well-known bulb method for the determination of the freezing points of mixtures of dotriacontane (dicetyl $C_{32}H_{66}$) with (1) butane and (2) propane. The amount of light hydrocarbon needed for any experiment was condensed in the bulb, already containing the dotriacontane, by utilizing a vacuum technique. The results obtained are shown graphically and in tables. Up to 50% (molar) concentration of dotriacontane, the curves for either butane or propane as the solvent, coincide. From here on the curves diverge until a very low concentration is reached, *e.g.* about 0·1% (molar) of dotriacontane. The curves indicate that at low temperatures the latter hydrocarbon is almost insoluble in butane or propane. The work has revealed the occurrence of two forms of dotriacontane. This was confirmed by examining the change of refractive index with temperature. The transition temperature was found to be about 55° C. W. E. J. B.

71. Alkylation of Aromatics with Olefins in Presence of Boron Fluoride. V. N. Ipatieff and A. V. Grosse, *J.A.C.S.*, 1936, **58**, 2339.—Boron fluoride, without acids, behaves as an alkylating catalyst. The alkylation of aromatic hydrocarbons with olefins, including ethylene, takes place in the presence of boron fluoride in a nickel-lined autoclave at room temperature and also at temperatures up to 250° C. A typical experiment concerned 250 mls. of benzene, 18½ gms. of boron fluoride and 2 gms. of water, treated with ethylene at 20 atmospheres for 8 hours at 20–25° C.

Over 25% of the benzene was alkylated to monoethylbenzene (21%), diethylbenzenes (3·0%), and higher alkylbenzenes. W. E. J. B.

72. Action of Aluminium Halides on *n*-Pentane. A. L. Glasebrook, N. E. Phillips and W. G. Lovell. *J.A.C.S.*, 1936, **58**, 1944–1948.—Dry *n*-pentane undergoes little, if any, decomposition at its boiling point in the presence of freshly sublimed aluminium chloride. This applies to *n*-pentane in either liquid or vapour form. Reaction can be started immediately by the introduction of various promoters, *e.g.* water, anhydrous hydrogen bromide or chloride, etc. With the liquid phase reaction, butanes and *iso*pentane have been identified in the products, the latter hydrocarbon being the chief product. Undefined saturated higher-boiling products and an insoluble unsaturated polymer are also formed. In the vapour phase reaction, the amount of *iso*butane formed is greatly increased, whilst aluminium chloride and anhydrous hydrobromic acid together form the most active catalyst. In moderate concentration, aluminium bromide is soluble in *n*-pentane, and is a very active catalyst in the decomposition reaction, the extent of which at room temperature depends on the amount of bromide present and the reaction time. As the latter increases, the amount of butanes formed increases linearly, whereas the amount of *iso*pentane formed reaches a maximum and slowly declines. As much as 55·9% of *iso*pentane was obtained. The addition of water, or the passage of anhydrous HBr through the reaction mixture, causes an increase in reaction velocity. W. E. J. B.

73. Thermal Stability of Paraffinic and Olefinic Hydrocarbons. G. Egloff and C. I. Parrish. *Chem. Rev.*, 1936, **19**, 145.—From information available in the literature the authors have compared, as far as is possible, the relative stabilities of paraffinic and olefinic hydrocarbons. The conclusions arrived at in this useful survey are :—

1. The relative stabilities of the paraffins towards decomposition decreases in the following order : methane, ethane, propane, *iso*butane, butane, *neo*pentane, *n*-pentane, *iso*pentane, *n*-hexane and 2-methylpentane.

2. The olefinic hydrocarbons undergo three type reactions : (*a*) formation of higher hydrocarbons by polymerization and other reactions, (*b*) decomposition, and (*c*) isomerization.

At 600° C. the stability of the olefins towards the formation of higher hydrocarbons decreases in the following order : ethylene, propene, 2-butene, and 1-butene ; but at higher temperatures this order is destroyed and then all appear to have approxi-

mately the same stabilities. At 371–457° C., under high pressure, ethylene is less stable than propene. These differences may be due to variations in experimental methods or conditions. Towards decomposition, the second of the characteristic reactions of olefinic hydrocarbons, the following order of decreasing stability is estimated for temperatures ranging from 600° to 700° C.: ethylene, propene, *iso*butene, 2-butene, 1-butene, trimethylethylene, 2-pentene and 1-pentene. *iso*Butene was found to be less stable than 1-butene at 1100° C. and 50 mm. pressure.

Towards isomerization, the third characteristic reaction of the olefins, 1- and 2-pentene are less stable than 1- and 2-butene, the latter two olefins having approximately equal stability. The stability of the pentenes decreases in the order: trimethylethylene, *iso*propylethylene, 2-pentene and 1-pentene.

3. Diolefins are more susceptible to polymerization than the mono-olefins. Further, the dimethylbutadienes increase in stability as the methyl group are moved from the centre of the molecule.

4. Specific conclusions regarding the relative thermal stabilities of paraffins and olefins cannot yet be made with any degree of certainty, owing to the lack of strictly comparable experimental data. H. E. T.

74. Ebulliometric and Tonometric Measurements on Normal Aliphatic Hydrocarbons. M. Wojciechowski. *Bur. Stand. J. Res.*, 1936, **17**, 453–458.—This work was carried out to establish exact data on boiling points and $\frac{dt}{dp}$ ratios—the rate of change of boiling point with change in pressure—as well as to investigate the relation between the constitution of a compound and the value of its $\frac{dt}{dp}$ ratio for a series of normal aliphatic hydrocarbons.

The method of measurement used has been described in detail by W. Swietoslawski, who has also published an ebulliometric test for the purity of liquid substances. The latter is based on the difference between the boiling and condensation temperatures in an ebulliometer of standard dimensions. For a pure substance or an azeotropic mixture this difference is zero, and it increases with the concentration of impurities.

Normal pentane, hexane, heptane and octane were examined, and the results showed them to be of a very high standard of purity.

The numerical data are as follows: *n*-pentane, b.p. 36·077°, $\frac{dt}{dp}$ 0·0391; *n*-hexane, b.p. 68·733°, $\frac{dt}{dp}$ 0·0420; *n*-heptane, b.p. 98·365°, $\frac{dt}{dp}$ 0·0449; *n*-octane, b.p. 125·658, $\frac{dt}{dp}$ 0·0477.

It was found that the introduction of a CH_2 group into the chain of each of the normal aliphatic hydrocarbons investigated has the specific effect of increasing the $\frac{dt}{dp}$ ratio by 0·0029. D. L. S.

75. Vapour Pressure of Hexaphenylethane. G. R. Cuthbertson and H. E. Bent. *J.A.C.S.*, 1936, **58**, 2000–2003.—The vapour pressures of triphenylmethane and hexaphenylethane have been measured by means of a quartz fibre gauge, over the temperature range 26–122° C. For the former, $\log p = -\frac{5260}{T} + 12{\cdot}72$, whilst for the latter, $\log p = -\frac{5987}{T} + 12{\cdot}85$. W. E. J. B.

76. Vapour-pressure Curve of Tetraethyl Lead from 0° to 70° C. E. J. Buckler and R. G. W. Norrish. *J.C.S.*, 1936, 1567–1569.—Pure tetraethyl lead was prepared from the commercial product by treatment with silver oxide to remove halides and subsequent distillation *in vacuo*; the pure substance was collected in vessels fitted

with vacuum breakers and coated black to prevent decomposition. The vapour pressures were determined by means of a very sensitive Bourbon gauge surrounded by a hot-air-jacket maintained at a temperature of 80° C.; the specimen was contained in a small bulb connected to the spoon side of the gauge, and precautions were taken to remove dissolved gases from the sample by repeated warming and freezing. The bulb was immersed in a small oil bath contained in a Dewar flask, the oil being maintained within 0·05° C. of the required temperature by means of an electrically heated stirrer. Displacements of the gauge-pointer were observed by means of a travelling microscope. A table is given of vapour pressures obtained from 0° C. to 67° C. and the relation between $1/T$ and log p (vapour pressure in mm. Hg) is linear. The results can be expressed by $\log_{10} p = 9{\cdot}428 - 2938/T$ between 0° and 70° C. This result differs from a previous published formula for temperatures between 78° and 150° (*J.C.S.*, 1935, 39), viz., $\log_{10} p = 9{\cdot}426 - 2960/T$, which in the present range 0–70 gives results 10–15% low. W. A. W.

77. Catalytic Reactions of Carbon with Steam–Oxygen Mixtures. A. W. Fleer and A. H. White. *Ind. Eng. Chem.*, 1936, **28**, 1301.—This work was undertaken in order to determine the effect of contact time, temperature, and oxygen concentration, to study the gasification reactions involved, and to establish the limiting conditions pertinent in the gasification of carbon with steam–oxygen mixtures.

Powdered coke (20–40 mesh), treated with 5% of sodium carbonate as catalyst, was gasified with steam–oxygen mixtures while falling through a steel reaction tube, 2 in. in diameter and 8 ft. long, and heated to 900–1000° C. The rate of steam decomposition was independent of the oxygen concentration and proceeded at a rate which followed a first-order reaction. For each 75° C. increase in temperature, the reaction rate was doubled, and the energy of activation was computed to be 26,800 cals./gram-mole. At 1000° C. and a contact time of 5 seconds practically complete decomposition of steam was obtained. Catalysis of the reaction $CO + H_2O = CO_2 + H_2$ occurred to such an extent that equilibrium conditions were operative, which controlled the CO_2 content of the gas produced, and set the limits for over-all decomposition of the inlet mixtures at a given percentage of steam decomposition. Additional results were obtained with a fuel bed 4 ft. deep, using catalyst-treated coke particles 0·5–0·75 in. in size. In these experiments the effect of oxygen indicated that the rate of reaction limited the extent of decomposition of the reactants. The steady-state grate temperatures attained in either case were proportional to the oxygen content of the inlet mixture and the total inlet rate to the 0·16 power. H. E. T.

78. Evolution of Heat on Heating Wood with Calcium Hydroxide and Water under Pressure. H. Bergström, K. N. Cederquist, and K. G. Trobeck. *Iva*, 1936, **4**, 118–125.—When granulated beechwood was heated under pressure with calcium hydroxide and water, water-soluble volatile products, mainly alcohols, oils and gases, were obtained, the remainder consisting of water-soluble calcium salts and insoluble residue. At 250° C. and 51 atm. the yield was 6·3% alcohols and 0·7% oils, and at 325° C. and 170 atm. 13·5% and 7·5%, respectively. As the heat content of the products was less than that of the original materials, numerous experiments were conducted to determine the evolution of heat during the reaction. It was found that 8–11% of the heat content of the beechwood is liberated after heating to 270° C. and then removing the source of heat. About 6% of the heat content of the beechwood is evolved when heating to 180° C. with water only. When the wood thus treated is heated with calcium hydroxide as before, there is only scant evolution of heat. Heating with calcium carbonate to 180° C. produced slight evolution of heat, but when the treated wood is heated with calcium hydroxide as before about 4·6% of the heat content is liberated. R. F. S.

Analysis and Testing.

79. Laboratory High Vacuum Still. E. A. Means and E. Newman. *Refiner*, 1936, **15**, 413–415.—A glass still is described for the production of a low-penetration asphalt

from crude oil without cracking. It consists of a round flask with a draw-off or filling tube sealed in at the bottom closed by a rubber tube with screw clamp. A Liebig condenser is sealed vertically on to an extremely short neck, in which are also sealed a trap ring and delivery tube of conventional shape. The thermometer for measuring the vapour temperature is suspended in the condenser. Vacuum is applied at the top of the condenser. It is shown that, with this type of flask, in order to remove a fraction of average mol. wt. 323 a temperature of 460° F. at 5 mm. was required, whilst with the normal side arm distilling flask the temperature was 550° F. G. R. N.

80. Determination of the Cloud Point of Dark Oil. W. R. van Wijk. *J.I.P.T.*, 1936, **22**, 754–760.—The method described consists of measuring the transmission of infra-red radiation by the oil at various temperatures. The formation of a cloud alters the intensity of transmission, and for an oil with a true cloud point this is sharply defined. For oils with transitional cloud points the change in intensity was not so marked. The apparatus and results are described. G. R. N.

81. Polar Height as Measure of Temperature–Viscosity Characteristics. E. Molin. *Tekn. Tidskr.*, 14.11.36, **65** (Kemi No. 11), 81.—At present the official Swedish Government specifications specify viscosity–temperature characteristics of lubricating oils by means of the quotient obtained by dividing viscosities in centistokes at 50° C. and 100° C. This is admitted to be unsatisfactory, and its replacement by Polar Height or V.I. is discussed. The greatest objection to the adoption of V.I. is the necessity of determining viscosities at 100° F. and 210° F. instead of 50° C. and 100° C., common in Sweden, where the Fahrenheit scale is almost unknown. R. F. S.

82. Permeability of Lacquer Films to Moisture. R. I. Wray and A. R. Van Vorst. *Ind. Eng. Chem.*, 1936, **28**, 1268.—The permeabilities of clear lacquer films have been measured, and in general show an increase with age. This fact makes the time of testing important when interpreting the data obtained. Permeabilities have been measured in contact with humid air and with liquid water, but behaviour with the latter is not consistent. The resistance of some films examined is apparently increased by baking, especially after ageing. H. C. R.

83. Significance of Diesel Fuel Knock Ratings. J. Liston. *Refiner*, 1936, **15**, 401–406.—Roughness and knocking in many new high-speed diesel engines are due in large part to too long delay between the time when the fuel begins to enter the combustion chamber and the time when it begins to burn. According to Ricardo, injection and combustion may occupy three stages: the ignition delay period, with negligible combustion, then combustion of fuel entrant and *in situ*, and finally combustion of the fuel as it enters. In stage 2 there is a rapid rise of pressure due to excessive heat liberation, which is clearly illustrated on an out-of-phase indicator card. Research results strongly indicate that diesel knock and roughness are closely associated with the rate of pressure rise evidenced in stage 2. Since this effect is due to retarded combustion in stage 1, the problem becomes one of reducing the ignition delay period. Method of attack may be divided into (*a*) changes in mechanical design, and (*b*) alteration of the combustion characteristics of the fuel. Increasing the compression ratio will increase the compression temperature, and so reduce the delay period, but this very definite advantage may be partly or completely offset by running under light load, uncontrolled air turbulence, over effective cooling, etc. The second method of reducing diesel knock is based on the setting up of rating scales for diesel fuels analogous to octane ratings, the reference fuels being cetane and a methylnaphthalene. While standardization is in a state of flux, these scales indicate that paraffinic oils and straight-run oils are more resistant to knock than asphaltic base and cracked oils, respectively. G. R. N.

Motor Fuel.

84. Natural Gasoline in East Texas. G. Reid. *Refiner*, 1936, **15**, 372–376.—A general account of the natural gasoline position in the East Texas field. Approximately 15,000 wells are connected to the various gas-gathering systems, and this number is steadily increasing. The production of natural gasoline has risen from 2,000,000 gal./month in 1933 to 10,000,000–12,000,000 gal./month. Operators estimate the probable life of the field as 15–25 years. East Texas gas is particularly rich in propanes and the butanes which it is believed will have a very profitable market in the near future. The manufacture of commercial natural gasoline 26/70 and heavier has already assumed an important magnitude, which has made itself felt in marketing circles. A list of active natural gasoline plants in East Texas is given. In conjunction with this review anonymous descriptions are given of the Hanlon, Gregg-Tex, Sabine Valley, Gilliland General and Hercules gasoline plants, as well as a short description of East Texas gathering systems by E. Sterrett. G. R. N.

85. Copper-Sweetening Process. W. A. Schulze and L. S. Gregory. *Nat. Petr. News*, 7.10.36, **28** (41), 34.—The process is based on the fact that, in the presence of a high concentration of chlorides, *e.g.* NaCl, cupric chloride oxidizes mercaptans completely to the corresponding disulphides. The reagent may be prepared as a solution from copper sulphate and sodium chloride, or as a solid contacting material by the impregnation of a suitable base with those salts. Regeneration of the reagent is rapid and complete by oxidation with air. The air may be supplied by dissolving it, in controlled quantity, in the gasoline charge, thus making the process entirely continuous. Subsequent colour instability due to the presence of traces of dissolved copper salts is prevented by treatment with alkaline sodium sulphide. Free sulphur is removed, either before or after " copper sweetening," by means of alkaline polysulphides. The process is claimed to be much superior to the plumbite process. The following advantages are cited: (*a*) the reagent lasts almost indefinitely; (*b*) sweetening costs are reduced by as much as 90%; (*c*) there is no loss of gasoline as occurs through sludging in the plumbite process; (*d*) the loss in octane number after treatment is smaller than with the plumbite process; (*e*) natural gum inhibitors are not removed, as they are by strong caustic solutions; (*f*) the absence of polysulphides ensures the quality of the gasoline from the point of view of the copper strip test. H. G.

86. Refining of Motor Fuels by Means of Floridin. M. R. Mandelbaum and C. H. N. Bensmann. *Petr. Zeit.*, 28.10.36, **32** (43), 1.—The Gray process is described, in which cracked spirit is refined by treating spirit vapours with Floridin, causing polymerization of the unsaturated hydrocarbons. R. K. Stratford passes cracked vapours countercurrent to a mixture of finely-divided earth and naphtha. The Osterstrom process treats cracked benzine at high pressures attaining polymerization temperatures in the liquid phase. Data are given for the processes described. They are applied also in refining polymer spirit. W. S. E. C.

87. New Refining Methods for Lignite Gasoline. B. Kwal. *Chim. Ind.*, 1936, **53**, 1040.—Straight-run lignite gasoline contains much diolefines. Their removal by the action of concentrated sulphuric acid is not preferable because of decrease in anti-knock value of the refined gasoline.

Diolefines form gums, especially in the presence of oxygen. This was proved by experiments with ozone oxygen-rich water and anti-oxidants. Sulphur compounds are also troublesome; thiophene, but also hydrogen sulphide, sulphur, mercaptans, disulphides and others, are present.

The following new method of refining is proposed: (1) pretreatment of the gasoline with oxygen-rich water; diolefines yield gum, hydrogen sulphide, sulphur and thiophene are partly oxidized into easily removable compounds; (2) treatment with Carnolit (a natural earth) humidified with oxygen-rich water; the residual thiophene,

gums and colouring matter will be eliminated; (3) lavage with water and alkali to remove acids; (4) doctor treatment to eliminate mercaptans and other sulphur compounds (a used doctor solution being more effective). The refined gasoline has a remarkable high octane number; its colour and odour are stable to storage.

P. C. K.

88. Destructive Hydrogenation of Rumanian Residual Oil from Moreni. C. Candea and A. Marshall. *Chim. Ind.*, 1936, **36**, 463.—Continuing their researches on destructive pressure hydrogenation in the presence of a MoS_3 catalyst, the authors now communicate the results of experiments with a raw residual oil hydrogenated at initial pressures between 100 and 300 atm. at 350° C.

The oil contained: 83·18% C, 12·09% H_2O, 3·18% S; the density was 0·908 at 15° C., its boiling point below 340° C.

The catalyst consisted of 13·4 g. MoS_3, 4·0 g. MgO, 2·6 g. Al_2O_3; 10% of the oil weight was used each time.

The following results were obtained: (1) the yield of liquid products boiling to 300° C. amounted to 70–80%; (2) investigating the rate of hydrogenation as a function of initial hydrogen pressure, it is stated that a maximum yield of gasoline boiling to 150° C. up to 44% was realized at 230 atm. hydrogen pressure; (3) this yield was also obtained for gasoline boiling to 200° C. with an initial pressure of 87 atmospheres; (4) 150° C. showed a diminishing content of unsaturated aliphatic and aromatic hydrocarbons simultaneously with an increasing content of naphthenic hydrocarbons when the initial hydrogen pressure is raised; the lower-boiling gasoline fractions are more saturated than the higher-boiling ones; (5) coke-formation decreases from 15 to 0%, and also the sulphur-content is lowered with increasing pressure. Hydrogenated gasoline is of better quality than cracked gasoline; it is more saturated and pure, less gumming and almost free from sulphur.

P. C. K.

89. Production of Gasoline and Lubricating Oils from Wood, Tar and Shale Oil by Hydrogenation. H. Bergström, K. N. Cederquist, and K. G. Trobeck. *Iva*, 1936, **4**, 125–132.—Production of petroleum products in Sweden is stated to lack promise, but the field is being investigated to determine the technical possibilities. The present paper describes work done to find a suitable catalyst. The raw material, liquid rosin chosen only for this particular purpose, was heated with hydrogen to 450° C. at about 80 atm. Yields and inspections for a number of different catalysts are given. $(NH_4)_2MoS_4$ was found to give the best results, the yields being 46·5% gasoline with E.P. 220° C. and sp. gr. 0·7537, and 22·9% heavy oil of E.P. 320° C. at 2 mm. Hg. In addition, 1·5% CO_2, 10·8% H_2O and 7·7% gases were formed. The results were not materially changed when small amounts of $Cr(OH)_3$ and $Zn(OH)_2$ were admixed to the catalyst. Further work in this line will be published later.

R. F. S.

90. Practical Aspects of Sun Stability. C. W. Berger. *Refiner*, 1936, **15**, 411–412.—Free sulphur, disulphides and polysulphides are probably chiefly responsible for the colour reversion of gasoline. Whereas unstable straight-run gasolines first form a white haze or cloud before reverting, cracked gasolines simply darken and revert, and in both cases gum and acidic substances are formed. Tertiary amines have proved successful in retarding these photochemical reactions, particularly with cracked gasolines. Measures for increasing the sun stability of straight-run gasoline are given as follows. The first step is to expose the gasoline to sunlight in 4-oz. bottles and assess its stability in colour units or other appropriate measure over given periods. The next step is to test the gasoline as it comes from the stripper, flash column or bubble tower, and, if still unsatisfactory after a lab. finishing treatment, to test the plan fractionating practice by a lab. crude-oil distillation. If there was slight cracking in the distillation, the presence of traces of cracked gasoline may cause reversion. If the gasoline is proved stable up to the sweetening plant, it may be contaminated here by free sulphur, phenols, cracked gasoline residues or soluble sulphur compounds. Free sulphur is removed by shaking with mercury, and the sunlight test is again

applied. The remaining contaminants can be detected by treating samples with fresh and plant doctor and comparing the sunlight tests applied. A water wash after sweetening improves sun stability. Serious sources of contamination are recovery gasoline and light ends of cracked gasolines when blended in to maintain volatility. If this practice must be followed, then it may be necessary to use acid on these products before blending to obtain the desired stability in the blend. G. R. N.

91. A New High-Octane Blending Agent. H. E. Buc and E. E. Aldrin. *J.S.A.E.*, 1936, **39**, 333–340.—*iso*Propyl ether has a vapour pressure of 5·3 lb. per sq. in. (Reid), which is below the maximum allowed for aviation gasolines. The freezing point (−125° F.) is satisfactory, and the latent heat of vaporization is comparable with *iso*-octane, so that no tendency to ice formation in the carburettor would be anticipated. Experiments indicate that *iso*propyl ether is soluble in water up to 1·5%, a point of some importance where blends containing this fuel are stored over water for long periods, and the solubility of water in such blends is discussed. Blends with this fuel have low gum contents, and with the addition of inhibitor show satisfactory resistance to oxidation. Curves are given which show that (*a*) the blending value of *iso*propyl ether is superior to *iso*-octane in unleaded blends, and is also superior for any fixed amount of T.E.L. in similar blends; (*b*) the amount of T.E.L. required for *iso*-propyl ether is less than for *iso*-octane containing the same concentration. It is stated that potential supplies of propylene, the raw material for making *iso*propyl ether, are sufficient to produce 340,000,000 gallons per year of the technical product, which, assuming that 100 Octane Fuel (using 3 c.c. T.E.L. per gallon) is required, is enough to produce 850,000,000 gallons of finished product per year. Blends of *iso*propyl ether and *iso*-octane have advantages over the individual fuels, especially as regards volatility, and a 50/50 blend of the two in C. 9 reference fuel has an anti-knock value superior to *iso*-octane alone as a blending fuel. Many curves are given discussing volatility and Octane Numbers, also tables describing physical constants, storage tests and characteristics of various 100 Octane Fuels as required by different Air Departments and others. W. A. W.

92. Patents on Motor Fuel. Carbo-Norit Union Verwaltungsges. mit Beschränkter Haftung, and W. H. A. Thiemann. E.P. 456,320, 6.11.36. Extraction of high grade motor fuels from crude benzenes by means of solid absorbents.

W. V. Overbaugh. U.S.P. 2,056,618, 6.10.36. Sweetening sour distillates by means of an alkaline solution of sodium plumbite and a suspension of lead sulphide in alkaline solution in the presence of sulphur.

G. Egloff and J. C. Morrell. U.S.P. 2,057,424, 13.10.36. Refining of cracked distillates by treating the vapours with added hydrogen chloride in the presence of an aqueous solution of a water-soluble mercury salt.

G. Egloff and J. C. Morrell. U.S.P. 2,057,629–2,057,630, 13.10.36. Refining of cracked distillates as described above by means of added hydrogen chloride and zinc oxide.

C. M. Ridgeway. U.S.P. 2,057,918, 20.10.36. Desulphurizing petroleum hydrocarbons without adding free sulphur by treatment with alkaline plumbite solution and ageing for several days at 60° F., and hypo-treating the aged oil and filtering through a solid absorbent material.

J. A. Reid and W. A. Schulze. U.S.P. 2,058,720, 27.10.36. Sweetening of distillates containing mercaptans with oxidizing solutions of copper halides.

R. B. Day. U.S.P. 2,058,958, 27.10.36. Desulphurizing of light distillates by passing the vapours with HCl countercurrent to a liquid hydrocarbon of higher b.p. than the distillate and having in suspension a metal oxide, the sulphide formed being soluble in HCl.

D. L. Yabroff and J. W. Givens. U.S.P. 2,059,075, 27.10.36. Sweetening of sour hydrocarbon distillates by extraction with alkali and extracting the liquid with methylbenzylammonium hydroxide. W. S. E. C.

Lubricants and Lubrication.

93. Comparison of Dewaxing Methods. D. Gol'dberg, I. Abezgauz and L. Margolis. *Azerb. Neft. Khoz.*, 1935, **10**, 86.—Gasoline is the least effective solvent in the dewaxing of light distillates. The dewaxing of heavy distillates may be carried out with the aid of Sharples centrifuges cooled down to the required temperature, although the consumption of heat is very high. Naphtha cannot be used for dewaxing of light distillates and wide fractions, because of the solubility of paraffins. Benzole–acetone can be used in the dewaxing of the wide fractions of lub. oils, as well as for the residual fractions of the redistillation and for narrow light fractions, whereby the dilution should be increased with the increase in the viscosity of the oil or with increasing width of the fraction. This lowers the selectivity effect. However, this method requires considerable refrigeration, although it is not so great as that for naphtha. A chloro-solvent requires the smallest amount of refrigeration and the lowest degree of dilution; it is recommended for the dewaxing of light fractions.
For. Petr. Techn.

94. Refining Dossor Aviation Oil with Nitrobenzene. Y. A. Pinkevich. *Neft. Khoz.*, 1935, **29** (11), 58–67.—Dossor aviation oil retains its low pour point after treatment with nitrobenzene while its other properties are improved. In this extraction of residual oils the light fractions in the above oil are extracted by the solvent, the obtained extracts have a lower viscosity than the original oil, and the refined oil has a considerably higher viscosity. The residual oil can be over-refined, thus increasing its viscosity, whilst an increased treating temperature—*i.e.* 50–100° C.—increases the percentage of carbon and lowers appreciably the yield, while improving the V.I. The Dossor residual oil should be treated at about 10° C. with 50% (by vol.) of the solvent, repeating the operation not more than five times. The Hill-Coats viscosity–temperature index was found to be the most suitable. For. Petr. Techn.

95. Acid Treatment of Oils. B. M. Ruibak. *Azerb. Neft. Khoz.*, 1935, **9**, 69–72.—It is stated that a prolonged contacting of distillates with acid causes sulphonation and lowers to a great extent the capacity of the treating units. Agitation with air causes polymerization, whilst mechanical agitation must be carried out at a speed which is characteristic for each distillate. Excessive speed breaks down the acid sludge to a dust-like substance, which is finely dispersed in the oil and is very difficult to coagulate and remove. For. Petr. Techn.

96. Oxidation of Lubricating Oils. R. W. Dornte, C. V. Ferguson and C. P. Haskins. *Ind. Eng. Chem.*, 1936, **28**, 1342.—The investigators present results obtained on the oxidation of lubricating oils in which the rate of oxygen absorption continuously decreases. This rate of absorption decrease is probably due to the decreasing concentration of reacting components, and not to retardation effects caused by the oxidation products. These oxidation products are found to be water, carbon dioxide and acids, small amounts of carbon monoxide and hydroxy-compounds were detected, peroxides were absent.

The rate of reaction is shown to vary directly with the partial pressure of the oxygen;

the net heats of activation for an oil of this type is found to lie between 33,000 and 73,000 cals. The catalytic action of copper, iron, tin and lead disclose that copper and lead, only, have a marked effect on the oxidation rate. Copper causes the rate of oxygen absorption to remain constant, hence a change in the type of oxidation is inferred to take place in the presence of this metal. J. W. H.

97. On the Temperature-Sensitivity of Mineral Oils with a High Viscosity. D. J. W. Kreulen. *Chem. Weekblad*, 1936, **33**, 466.—The influence of the various constituents which are separately obtained in the determination of asphalt, *e.g.* normal petrol filtrate, n.p. extract, alcohol extract, asphalt, was investigated. Asphalt as a whole is not responsible for temperature-sensitivity of the oil. Substances which are entirely different from mineral oils, such as honey, also exhibit the phenomenon. The graph for honey shows two peaks, the second of which is connected with the solution of the waxes.

Only oils with a sufficiently high viscosity show the phenomenon, which disappears on dilution with an oil of low viscosity and of the same setting point as the normal petrol filtrate derived from the temperature-sensitive highly viscous oil. The disappearance is fully connected to the change in viscosity and to the decrease of the asphalt percentage on dilution. An oil which gives a low value, after preheating to 100° C., can be redressed to the higher value by inoculating with a little of the unheated oil. Although the asphalt is not responsible for the temperature-sensitivity, it acts as a retarder. Hence after inoculation one remains further away from the maximum, on account of a greater asphalt content. The setting point of temperature-insensitive, low viscous oils can also be lowered by addition of asphalt. Phenomena similar to those at the setting point also appear in the viscosity determination at relatively low temperatures. It is therefore desirable to indicate the preheating temperature attained before viscosity determination. This is connected with the gradual disappearance of a disperse phase with rise in temperature. With regard to the shape of the setting-point curves, the fall above 50° C. can be explained by a retardation of crystallization such as frequently occurs in viscous media. The rising portion up to 50° C. cannot be explained with certainty. Since, however, the maximum is found at approximately the temperature at which complete solution of the solid paraffins occurs, it seems not impossible that in this range of temperature the max. concentration is reached on one side; on the other side the remaining crystal nuclei are the cause of suddenly crystallization observed by cooling down the liquid during the experiment, whereby a relatively stable network of very fine crystals may be formed according to microscopical observation. P. C. K.

98. Oiliness in Motor Oils. Part III. S. Kyropoulos. *Refiner*, 1936, **15**, 356–358.—This concludes the series, and is devoted to a general discussion on adsorption phenomenon and orientation on surfaces with reference to the work of Langmuir, Harkins, Hardy and Adam. G. R. N.

99. Patents on Lubricating Oil. Texaco Development Co. and F. X. Govers. E.P. 454,690, 6.10.36. Solvent extraction of lub. oil using nitrobenzene or furfural.

C. C. Wakefield & Co. and E. A. Evans. E.P. 455,235, 15.10.36. Extreme pressure lubricant prepared by dispersing a small quantity of a thio-ether in a lub. oil-or grease.

Texaco Development Co. and W. P. Gee. E.P. 455,272, 12.10.36. Dewaxing of hydrocarbon oil by filtration.

E. I. Du Pont de Nemours & Co. E.P. 455,304–455,305, 19.10.36. Improved lubricant prepared by dispersing a nitro-arylamine with an unsubstituted amino-group in a viscous liquid hydrocarbon or grease.

H. A. Ambrose. U.S.P. 2,056,594, 6.10.36. Preparation of lubricant jelly by dissolving a hard wax of high m.pt. at temperatures below 155° F. in a normally liquid petr. lub. oil.

E. C. Herthel. U.S.P. 2,056,723, 6.10.36. Dewaxing of lub. oil using normal butyl valerate.

J. Robinson. U.S.P. 2,057,113, 13.10.36. Purification of dichlordiethyl ether used for solvent extraction of lub. oils.

E. J. Slater. U.S.P. 2,057,923, 20.10.36. Production of lub. oil by vacuum distillation from crude oil, dewaxing and removing asphaltic and unsaturated compounds by successive acid and clay treatments.

P. J. Carlisle. U.S.P. 2,058,131, 20.10.36. Refining of lub. oil by means of molten sodium and an adsorbent substance in the liquid phase.

J. F. Wait. U.S.P. 2,058,534, 27.10.36. Refining of lub. oil by extraction with SO_2 and then passing the extract, free from solvent, in the vapour form at 300–500° C. through several zones containing alkali metal.

G. L. Matheson. U.S.P. 2,058,899, 27.10.36. Production of viscous liquids for use in shock absorbers by adding a plastic or viscous hydrocarbon polymer to an oil of low viscosity.

D. P. Bailey, R. Beattie and W. S. Tyler. U.S.P. 2,058,944, 27.10.36. Dewaxing mineral oils by filtration using a metallic cloth.

D. B. Banks and P. D. Barton. U.S.P. 2,059,166, 27.10.36. Propane-dewaxing of lub. oil.

Standard Oil Dev. Co. E.P. 455,735, 27.10.36. Manufacture of grease by blending a lime soap with a lub. oil to form a grease, and then incorporating it with a dispersion of natural rubber.

Standard Oil Dev. Co. E.P. 456,422, 9.11.36. Dewaxing of lub. oil by means of a halogenated hydrocarbon solvent. W. S. E. C.

Asphalt and Bitumen.

100. Chemical Properties of Modern Bituminous Road Materials. N. W. McLeod. *Nat. Petr. News*, 30.9.36, **28** (40), 35; 21.10.36, **28** (43), 32.—Marcusson is quoted on the classification of the constituents of asphaltic bitumen into: (1) oily constituents; (2) asphaltic resins; (3) asphaltenes; (4) carbenes; (5) asphaltic acids and their anhydrides. (1) are regarded as the most inert of the constituents. (2) are derived from (1) by oxidation, and are brown to red solids, melting at 200° F. or higher temperatures. (3) are formed by the further oxidation and/or polymerization of (2). They are brown to black in colour, infusible and form colloidal suspensions (solutions) (?) in CS_2 and CCl_4. (4) result from the polymerization of (3), are soluble in CS_2 but insoluble in CCl_4, and, like (2) and (3), are considered to be polycyclic in structure with O_2 and S in bridge and heterocyclic linkages. (5) may be removed from the bitumen by extraction with water after saponification with alcoholic potash. At high temperature they become unsaponifiable. Nellensteyn describes bitumen as a colloidal suspension of asphaltenes in an oily medium. He suggests that the asphaltenes consist of a nucleus of solid hydrocarbon surrounded by a shell of ionized asphaltic resins, a view which the present author criticizes. Mack supports the colloidal system view, but

suggests that asphaltenes and carbenes are separate entities with part of the resins adsorbed by means of secondary valency forces. The preparation of bitumen by straight distillation, "blowing" and cracking are discussed briefly. Bitumen from a cracked stock has a higher specific gravity and ductility, greater susceptibility to temperature change, and lower consistency than a straight-run bitumen of the same softening point. Cut-back bitumens are divided into three classes: Rapid-Curing (R.C.) with gasoline-type flux, Medium-Curing (M.C.) with kerosine flux, and Slow-Curing (S.C.), which may be a semi-solid residue without added flux. Bituminous emulsions are dealt with superficially from the point of view of methods of manufacture and the emulsifying agents used. A survey of the methods of testing bituminous materials includes a criticism of the 100 pen. residue test in favour of distillation to 680° F. and the testing of the distillation residue. In dealing with the use of asphaltic bitumen in road construction, the relative adhesion tension, with respect to road-stone aggregates, is dealt with. It is stated that bitumens of higher consistency possess a greater resistance to displacement by water than lower-consistency bitumens, because of their great relative adhesion tensions. On the basis that adhesion tension is an aspect of the polar properties of the materials concerned, an increase in the asphaltene content of the bitumen should increase the adhesion tension. This is not always the case, the reverse being sometimes true. This fact is explained in the assumption that a smaller quantity of more finely dispersed asphaltenes may increase the polarity of the bitumen more than a larger quantity of coarser asphaltenes.

H. G.

101. Physical Chemistry of Asphaltic Bitumen. R. N. Traxler. *Chem. Rev.*, 1936, **19**, 119.—This comprehensive survey of the above subject includes 124 references, and reviews the subject-matter under the following headings: Origin; Nature of hydrocarbons present; Action of organic solvents; Colloidal properties; Optical properties; Surface tension; Interfacial tension between asphaltic bitumen and water or aqueous solutions; Adhesion of bitumens to solid surfaces; Flow properties. Data are given illustrating the various theories and properties under consideration. J. W. H.

102. Patents on Asphalt. H. I. Ringgenberg. U.S.P. 2,057,265, 13.10.36. Manufacture of asphalts from petroleum residues by air-blowing.

T. Robinson. U.S.P. 2,058,913, 27.10.36. Production of asphalt cutbacks.

J. W. Sparks. U.S.P. 2,059,051, 27.10.36. Production of road oils from pressure tar by injecting dilute chlorine into the tar at 80–300° F. W. S. E. C.

Special Products.

103. White Oils by SO_2 Treatment. E. M. Velikovskaya and G. M. Shikhutskaya. *Neft. Khoz.*, 1935, **29** (12), 62–64.—The amount of SO_2 consumed in treatment of light distillates is 15–25% (recalculated on oleum), whilst 46–65% of oleum is needed to produce the same effect of refining. Thus up to 30–40% of acid can be saved when using gaseous SO_2 on the original product or 60–80% on the finished product. A great saving of time is also effected in the transfer of the treated oil because the acid sludge is completely water soluble in the cold. The obtained sulphonic acids are of high quality, and the acid sludge itself may be used in splitting of fats.

For. Petr. Techn.

104. Halogenated Hydrocarbon Solvents. P. J. Wiezevich and H. G. Vesterdal. *Chem. Rev.*, 1936, **19**, 101.—A resumé is given of the literature dealing with the halogenation of paraffins and olefines containing up to seven carbon atoms. Data are also

given on the chlorination of cracked gases, stabilizer bottoms and SO_3 extracts. Physical data are tabulated on a large number of halogenated hydrocarbon solvents, together with a discussion on their relative stability, inflammability, toxicity and solvent power (as measured by the kauri-butanol test). Where possible, attempts are made to correlate these properties with chemical structure.

Flash-points and ignitable concentrations are given for a number of mixed solvents, blended in varying proportions. Fluorinated compounds possess the advantage of physiological inertness. J. W. H.

105. Cellulose Mixed Ester Lacquers. C. R. Fordyce, M. Sale and G. R. Clarke. *Ind. Eng. Chem.*, 1936, **28**, 1310.—The cellulose mixed esters, and particularly the acetate-propionate and acetate-butyrate, have been examined as to their suitability in practical solvents for compositions useful in the lacquer industry. Satisfactory combinations may be obtained, but limited ranges of composition exist. H. C. R.

106. Patents on Special Products. J. Y. Johnson. E.P. 454,668, 6.10.36. Production of mercaptans of high mol. wt. by treating vapour-phase saturated or unsaturated aliphatic or *cyclo*aliphatic alcohols containing at least 12 carbon atoms/mol. with H_2S at 150–450° C. and in the presence of a catalyst, *e.g.* bauxite.

J. Y. Johnson. E.P. 454,675, 6.10.36. Production of organic sulphur compounds by reacting a vinyl sulphide or sulphoxide with sodium bisulphite. W. S. E. C.

Detonation and Engines.

107. Kinetics of Oxidation and Inflammation of Hydrocarbons. M. Prettre. *Ann. des Comb. Liq.*, 1936, **11**, 669–718.—The author has studied the combustion of mixtures of normal pentane and oxygen between 250° C. and 330° C. and at pressures between 100 and 750 mm. The usual static method has been used, and throughout the greater part of this range spontaneous inflammation, with very variable delays, has been observed. The delay periods have varied from over 300 seconds to less than 1 second. The delay period, τ, at constant temperature is governed by the equation, $\tau \cdot Pc \cdot P_t^2 = \text{constant}$, where Pc = partial pressure of pentane and P_t = total pressure. This equation was not verified for all concentrations of pentane. The lower limit of validity of the expression depends on pressure and temperature, whilst the higher limit is an equimolecular mixture of pentane and oxygen. The latter mixture burns the most rapidly of all, irrespective of pressure or temperature. During the delay period, τ, the mixture is the seat of a slow oxidation process, which is easily followed by the variation in pressure Δp, which is produced. The following equations are found to fit the data fairly well: (1) $\Delta p = ke^{qt}$ where t = time, (2) $\phi = k^1 Pc P_t^2$. Equation (2) confirms the validity of the expression $\phi\tau$ = constant. These results are in accord with the theory of ramified chain reactions, and the verification of these formulæ supports the view that the combustion of pentane is a chain reaction. The product $\phi\tau$ diminishes very rapidly as the temperature rises from 260° C. to 280° C., and then more and more slowly as the temperature rises further. At 10 atmospheres pressure a mixture of pentane and air will spontaneously inflame when the temperature reaches, though for only a hundredth of a second, a value rather below 350° C. Such conditions are often easily exceeded in the cylinders of I.C. engines, and the experiments described thus confirm the existence of a clear connection between detonation and the rapidity of the occurrence of an explosive reaction under these conditions.
W. E. J. B.

108. New Characteristic Power Curves. G. Simon. *Ann. des Comb. Liq.*, 1936, **11**, 611–668.—The variations in power output and petrol consumption have been studied with reference to mixture strength and input pressure. A 4-cyl., 8-h.p. Citroen engine was used, with 5/1 compression ratio and 68-mm. bore × 100-mm. stroke. The car-

burettor was replaced by the apparatus described by Puisais and Moynot (*Ann. des Comb. Liq.*, 1935, **10**, 663), which allowed complete control over air pressure and mixture strength. The latter is expressed as the ratio between the actual weight of petrol used and the theoretical weight for just complete combustion. The temperature of the inlet mixture was kept at 29° C. and the cooling water at 65° C. Various graphs show the power and petrol consumption as functions of mixture richness for various inlet pressures. At 700 mm. pressure economic working is given by a mixture strength of 1·0; as the throttle is closed, the best results are obtained, with slightly richer mixtures, *e.g.*, 1·1 for 400 mm. pressure. Maximum power is given in all cases by a mixture strength of 1·3. The shape of the power curves is essentially the same at all pressures. The heat absorbed by the cooling water is greatest when the mixture strength is 1·25 (for high pressures) and 1·15 (for low pressures), whilst the temperature of the exhaust gases falls steadily as mixture strength increases. The efficiency as a function of mixture strength at various speeds is shown graphically. At high pressures the maximum efficiency is at a mixture strength of 1·0, with a linear decrease. At low pressures maximum efficiency is found at about 1·15 mixture strength, but the decrease is not linear. A complete series of graphs presents all the above results in terms of (1) mixture strength and (2) speed. At all speeds the power output increases linearly with the inlet pressure over the range examined, *i.e.* 400–700 mm.

The author hopes to determine a coefficient for all engines of the same series which, given the relation between power at a given speed, mixture strength and inlet pressure, will allow calculation of the power at the same speed and mixture strength, but with a different inlet pressure. W. E. J. B.

109. Combustion System of Small High-Speed Compression Ignition Engines. J. H. Pitchford. *Engineer*, 1936, **162**, 592–593.—Consideration is given to oil engines of swept volume under 500 c.c. per cylinder, and the relative suitability for this application, of types employing direct injection, and those with a separate combustion chamber, is discussed.

Although the efficiency of the direct-injection engine is superior to any other arrangement, some serious difficulties arise in the design of very small engines with this combustion chamber. The two most important limitations are: first the realization of a rapid and intimate mixing of the fuel and air consistent with high volumetric efficiency, and, secondly, the practical difficulties involved in the manufacture of the fuel-injection system. The author considers that these difficulties are not so serious in the case of engines with separate combustion chambers.

It is believed that the useful speed range of the small compression ignition engine will be no more limited than that of the petrol engine. J. G. W.

110. Present Position of Special Steels for the Heavy Oil Engine. S. F. Dorey. *D.E.U.A.*, S. 132.—A survey is given of the part played by special steels in the construction of slow- and high-speed heavy oil engines.

Tables are given showing the steels used for various component parts, together with typical analyses and hardening and tempering treatments. J. G. W.

111. Patents on Engines. Improvements in Fuel Admission Systems for Internal Combustion Engines. W. W. Triggs. E.P. 453,766, 14.9.36. The invention relates to fuel metering devices for internal-combustion engines in which the fuel delivery is controlled by the pressure in the induction manifold. Claims are made for devices which compensate for atmospheric temperature and pressure variations.

Improvements in Electrical Indication of Engine Cylinder Pressures and other Variations. E. S. L. Beale and R. Stansfield. E.P. 453,887, 21.9.36. A method of integrating or differentiating an electrical variation of a given wave form is claimed in which the output from an elementary differentiating or integrating circuit is in-

creased without appreciably affecting the accuracy. A further claim is made in the correction of certain errors by feeding from the output side of the circuit to the input side, a compensating voltage of suitable phase and amplitude. J. G. W.

Coal and Shale.

112. Synthetic Petroleum and its Derivatives. G. Hugel. *Ann. des Comb. Liq.*, 1936, **11**, 719–733.—The author considers that, sooner or later, supplies of natural petroleum will not be sufficient to meet demands and synthetic petroleum will be necessary. Some fundamental considerations re the hydrogenation of coal and coal oils are discussed, with particular reference to the process used at the Béthune mines. An installation has been erected here capable of handling 50 tonnes of coal a day. The coal is finely ground and suspended in a liquid vehicle, *e.g.* heavy tar oil. Hydrogenation is effected at 200 kg./cm.^{2} and at about 450° C. The products are separated into three fractions—gas, light oil, and heavy oil. The crude light oil has a density of 0·97 to 0·98, distils between 40° C. and 300° C. and contains about 10% of phenol and cresols. The heavy oil is recycled after distillation to eliminate heavy pitch, and the crude light oil is hydrogenated in the vapour phase to yield an oil distilling up to 200° C., which is refined in the same way as benzole. The final spirit produced has a gravity of 0·84 (approx.) and a high octane number (not stated), by reason of its high aromatic content. The author discusses the economics of hydrogenation, and concludes that hydrogenation, whilst solved from a scientific and industrial viewpoint, is still economically unsound.

The synthesis of lub. oils is next discussed. The most promising line of attack is considered to be the chlorination of paraffin wax, followed by condensation with acyclic hydrocarbons, in the presence of active aluminium. The preparation of suitable lubricants from coal products is discussed. Lack of knowledge regarding the mechanism of viscosity renders this task more difficult. The problem is to combine in one molecule the properties of good viscosity/temperature characteristics and simultaneous protection against oxidation. W. E. J. B.

113. Profits and Drawbacks of the Bergius and Fischer Processes of Manufacturing Synthetic Fuel. Ch. Bertholot. *Chim. Ind.*, 1936, **33**, 768.—These two processes are said not to be competitive with each other, but are to be regarded as supplementary, each dealing with a different raw material.

The details are derived from figures and information regarding German, Italian and English plants.

The Bergius process operates in two stages. In the first young bituminous powdered coal, containing 10·8% H, fusain poor, durain rich, emulgated in a heavy oil, is transformed into tar, kerosine, gasoline and gas by catalytical cracking hydrogenation under high pressure in the liquid phase.

Attention is paid to the preparation and the composition of the catalyst. In the first stage Ti, Ge, SnO_2, Pb combined with Fe, Zn, J, Ni-oleate are used; alkaline coal ash is harmful, and has to be neutralized by gaseous hydrogen chloride.

In the second stage Mo and Wo sulphides on aluminium gel are used. Aluminium gel is preferred to activated coal, which cannot be revived.

The gasoline yield rises to 40% of the coal weight, with a consumption of 2000 m.^{3} of hydrogen.

The Fischer process uses water-gas as a raw material. In Germany the remarkable result has been obtained of gasifying coal of 6–30 mm. diam., the yield being 72%.

Six different processes liquefy the water-gas to synthetical fuel or lubricant.

Co and Fe are used as a hydrogenating catalyst, together with Cr_2O_3 and ZnO, promoting polymerization. Its durability lasts 3 months and it can be easily regenerated. A yield of 35% can be obtained. P. C. K.

114. Manufacturing of Lubricants from Coal and Ligneous Matter. Ch. Bertholot. *Chim. Ind.*, 1936, **36**, 370.—Continuing his article on the Bergius and Fischer processes,

elucidating the technical and economical value of those for gasoline production, the author summarizes proposed synthetic lub. oil processes, according to the scheme of Nash:

(1) A non-catalytic polymerization of ethylene hydrocarbons. Its reaction velocity is increased by electrical discharges of a Siemens ozonizer, *e.g.* the Voltol and Electrion processes.

(2) A catalytic polymerization of ethylene hydrocarbons. Catalysts are mineral acids, bleaching earths, metals and salts, *e.g.* Cr, Fe, Ni, Cd-phosphate, $AlCl_3$, $BoEl_3$. The last named two salts are used in the Fischer process dealing with "kogasin."

(3) A thermal decomposition of chlorinated hydrocarbons, occasionally in the presence of a catalyst.

(4) A condensation of olefines with aromatic hydrocarbons (benzene, naphthalene) promoted by the action of catalysts, $AlCl_3$, etc.

(5) A condensation of aromatic hydrocarbons with alkyl chlorides in the presence of $AlCl_3$; *e.g.* paraflow. These schemes have but little technical significance.

P. C. K.

Economics and Statistics.

115. U.S.S.R. Official Figures for Soviet Oil Operations. J. Wegrin. *World Petr.*, 1936, **7**, 609–612.—A statistical table shows that the drilling and refining divisions have been steadily progressing during the first 9 months of 1936, but the production division has fallen behind, and is now about 11% below plan fulfilment. Therefore to reach plan quota of 213,500,000 brl. for 1936, some 70,000,000 brl. must be produced in the last quarter. Efforts will be made to increase production to a total of 57,000,000 brl. for this last quarter, which would be possible with increased drilling at a better speed, but weather conditions at this time of year may be detrimental to such a result. The Soviet oilfields outside the Caucasus dropped off alarmingly in production up to September 30th, but these fields supply only from 12 to 14% of the total for all Russia, and would not matter much had not Baku, the mainstay of Russia, also progressively fallen behind plan fulfilment, reaching a drop of 11% for September. On September 5th, 1936, S. Ordzonikze, Commissar for Heavy Industries, issued an order from Moscow to bring the Russian oil industry again under sound working conditions, wherein he animadverted on the shortcomings, detailing the main causes for them, especially mentioning that geological prospecting lacked geophysics and was carried on haphazardly without adequate returns. The order exacts that during 1937 not less than 14 new oil regions must be brought under operation, and within the same year 20 new oil regions must be prospected for commercial development. A list of 10 areas is given on which new developments must be carried out from 6 of which a total production of not less than 33,520,000 brl. are demanded for 1937. Finally, strict orders were given to do away with all breakdowns and cave-ins at wells, and a list is given of the equipment and material commandeered from various factories.

B. F. N. M.

116. Sakhalin. Tinder Box of the Far East? Anon. *World Petr.*, 1936, **7**, 577.—M. L. Rukhinoff, Assistant Peoples Commissar for Heavy Industries, and Admiral Sakonji, Chairman of a Japanese Oil Company, signed on October 10th in Moscow a supplementary agreement to the Japanese Northern Sakhalin Concession contract of December 1925, whereby the holders of the Concession can continue exploratory drilling for oil for another 5 years from December 1936. The amendment of certain conditions in the original Concession gives further advantages to Russia, whose benefits accruing from these agreements are so much superior to those of Japan that it seems incredible that Japan can operate her share of the lands under the Concession with success. The average production of Sakhalin crude oil over a period of 6 years from January 1st, 1930, to January 1st, 1936, was 2,874,333 brl./annum. Japan consumes about 10,000,000 brl./annum, of which less than 2,000,000 brl./annum is produced in the country, the balance coming from Netherlands, India and the U.S.A. Originally Chinese territory,

control of Sakhalin island was taken by Russia in 1857, but the southern portion was ceded to Japan in 1905 after the Russo-Japanese War. In 1917 Japan took possession of Russian Sakhalin, and only returned it to Russia in 1925, when Japan obtained the 40 years Concession contract for exploratory and drilling rights over certain parts. Such a dependable and easily accessible oil supply is of such importance to Japan that it seems inevitable the northern Sakhalin oilfields and area will come more under the power of Japan; perhaps she may attempt to repeat the 1917 annexation.

B. F. N. M.

BOOKS RECEIVED.

American Petroleum Institute. Proceedings Sixth Mid-Year Meeting, May 1936. Section III, Refining; Section IV, Production. New York, American Petroleum Institute, 1936. 50 cents each section.

The Refining Section contains papers on Lubrication, Refining, and Dewaxing. The Production Section includes abstracts of papers on Drilling and Production Practice, together with reports of the Standing Committees on Production and of the Standardization Committees.

Fuel Research Board. Report for the Year ended March 31st, 1936. Pp. x, 217. London, H.M. Stationery Office, 1936. 4*s*. 0*d*. net.

The report deals largely with the increased efficiency in the use of coal, which in the last few years has resulted in considerable reductions in consumption.

In connection with the conversion of tar into motor spirit the semi-commercial scale plant at the Fuel Research Station has worked satisfactorily during the year.

Experiments on the production of a first-class lubricating oil from coal have been continued, but without success. The most useful line of attack appears to be the use of oils obtained by synthesis from carbon monoxide and hydrogen, and a plant for this purpose is being erected.

Measurement of the Non-Skid Properties of Road Surfaces. G. Bird and W. J. O. Scott. Pp. vi, 19. Road Research Bulletin No. 1. London, H.M. Stationery Office, 1936. 9*d*. net.

Studies in Road Friction. I. Road Surface Resistance to Skidding. G. Bird and W. J. O. Scott. Pp. vi, 66. Road Research Technical Paper No. 1. London, H.M. Stationery Office, 1936. 1*s*. 6*d*. net.

Apparatus for comparing the "slipperiness" of road surfaces has been developed at the Road Research Laboratory of the D.S.I.R. The machine consists of a motor cycle and sidecar in which the sidecar wheel can be set at an angle to the direction of travel. Bulletin No. 1 describes the construction and operation of the outfit, which has been in regular use for a number of years.

The Technical Paper summarizes the results of a large number of measurements of road friction under varying conditions, and includes a number of deductions and conclusions reached from the measurements.

Tabular Summary of State Specifications for Liquid Asphaltic Road Materials. U.S. Bureau of Mines. Supt. of Documents, Washington, D.C., 1936.

In 1934 the Bureau of Public Roads of the U.S. Department of Agriculture prepared a tabulation of specifications and testing methods for liquid asphaltic road materials of the various States. The circulation of this was instrumental in calling attention to the variety of testing methods and specification limits in use.

As a result of requests, the U.S. Bureau of Mines decided to revise the 1934 tabulation. The present tables include a smaller number of testing methods and the specification limits are much more nearly uniform, indicating that progress has been made towards uniformity in these matters.

ABSTRACTS.

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Geology.

117. General Properties of Petroliferous Deposits. de Cizancourt. *Ann. des Comb. Liq.*, Nov.–Dec. 1936, **11** (6), 997–1069.—This Memoir begins with a detailed examination of the facies of a petroliferous series. How exactly oil is formed is unknown, but precision as to where it is found is possible to achieve. Various hypotheses as to the organic connection of oil with the Flysch or with salt have been evolved, but the only definitely accepted one is that oil and a marine facies show an intimate affinity. Rapidity of sedimentation, causing the deposition of a very thick series, defines the zones of subsidence. Subsidence is not the cause of the particular thickness, the origin of which is intense erosion of adjacent land. The terrestrial crust tends constantly to elevation in certain parts and subsidence in others. The migration of oil involves the question of the porosity of sands and of productive limestones, the last-named having a higher percentage of porosity than the former. Oil is not found at the places where it was formed. The tremendous concentrations of big oilfields result from local accumulations drawing to one head after long circulation in their reservoirs. Unfortunately, if the place of migration culmination is recognizable, its point of departure is generally uncertain, the mother rock not being certainly identified. Three possible methods of migration are: (1) Migration from argillaceous rocks to adjacent porous rocks (primary migration). (2) Migration in the porous rock ending in an accumulation in certain favourable places (secondary or lateral migration). (3) Migration from one porous rock towards another porous rock separated from the first by impermeable beds (transversal or vertical migration). Under primary migration the argument is that it is very difficult to concede that oil is found in the same bed as that in which it is formed. Again, in the North American Continent oil is found in reservoirs which have suffered erosion for a long time before the deposition of the beds which directly cover them, suggesting that the oil had migrated from the touching transgressive beds. The phenomenon of primary migration is attributed primordially to the sinking or squeezing of the sediments. Athy, Hedberg *et al.* have shown that the water content of argillaceous which is 70 to 90% in freshly deposited muds finally falls to 5% in argillaceous strata buried at a depth of 2000 metres. Calcareous beds are affected in the same way by squeezing, but sands are much less susceptible to compression. Quoting Versluys, the author traces the expelled water after it leaves the argillaceous beds into an extremely slow circulation in the reservoir rocks. After referring to the laboratory experiments of Illing, Van Mills and others, he states that McCoy arrived at the same result without the help of compression merely by the simple action of the progressive replacement of oil by water in the slightly porous mud rocks. Once in high porosity rocks oil cannot leave the porous rocks and impregnate again an argillaceous rock.

Secondary migration follows very nearly the anticlinal theory, or gravitational theory. Versluys has shown that water expelled by pressure from argillaceous beds can escape not only through outcrops, but also by all the high points of reservoir rocks. Mackenzie Taylor shows that argillaceous rocks are never impermeable, with the exception of sodium clays hydrolized by a pure water circulation. The very complex problem of oil accumulation is dependent on a great number of factors, the most important being the difference of density and the movements of water acting on the differences of porosity which leads to the arrival of the oil in the very porous high points of reservoirs.

Transversal or vertical migration is generally not very important in nature. Such movements do occur: (1) When a porous bed becomes imposed in transgression on another bed competent to act as a reservoir, then oil accumulation in the latter can ultimately enter the superincumbent porous bed. (2) When open faults allow a circulation.

Clays which are very plastic on the surface become compact at relatively great depth, and can fracture similarly to hard rock; but it is accepted from present-day observation that most dislocations develop slowly with wide variations in degree of movement. Diastrophic periods when altering the altitude and form of a reservoir will also attack the hydrostatic equilibrium, whilst continuous erosion will allow superficial water to penetrate. From the time when the equilibrium of the fluids is broken, they will have a tendency to displacement, and the waters will carry along the oil coming from the accumulations prior to the rupture to other points; new

accumulations will thus be made, and the old ones will be destroyed. From oil migration the argument takes up the discussion of the accumulation of oil to the culminating point. Whatever the origin and methods of migration of oil may be, it ends by concentrating in a porous rock, generally sand, sandstone, or limestone, in which it is mixed in connate waters which impregnate it. It is displaced with them until its progress is stopped by an abnormal barrier, and then forms an oil pool. A porous horizon sufficiently developed is a primordial condition.

Structural conditions of accumulations can be classified as: I. Closed Reservoirs. A. Monoclines: Lenticles, Truncation by discordance. B. Folds: Domes and Anticlines, Terraces and Periclines, Faults, Rock Sheets, Outliers. C. Folds with piercement Cores: Salt Domes, Domes with eruptive Cores. II. Open Reservoirs: Open Monoclines, Monoclines sealed by Asphalt, Open Periclines. III. Difference of Porosity: Porous Lenticles in Sandstone; Altered Eruptive Rocks. A most perplexing problem from the viewpoint of the arrival of the oil in place is that of oil-fields in which the closure of the reservoir is formed by its transgressive cover by impermeable rocks. Such a case is East Texas. This phenomenon is most puzzling as to the origin and the arrival in place of the oil. The oil cannot have been stored in an eroded reservoir without escaping during the long period in which it remained without closure. It could only arrive in place after the discordant cover had closed the area of the oil pool. In the case of the East Texas field, where the transgressive Woodbine sand was covered by the Eagle Ford marl horizon, during a secondary discordance both the sand and its cover were eroded, and a further stage, the Austin Chalk, supervened to recover both of them. The accumulation of oil in this field can have arrived in the reservoir only after the transgressive deposit of the Austin Chalk. The progressive accentuation of tectonic movements by tilting oscillation has effected the destruction of some pools and made the covering incompetent; the oil has then migrated towards new structural traps, and has been able to reach structures at some previous stage eroded and later transgressively covered. Pools showing this kind of phenomenon are provocative of conjecture as to the date and mechanism of the final accumulation. After discussing and giving instances of various anomalous structures containing oil pools which seemingly contradict the anticlinal theory, the Memoir proceeds to the distribution of oil gas and water in a petroliferous series, and thereafter to the constitution and origin of oil, and gives a constitution divided into four groups.

On the subject of origin the author discards the inorganic theory, and finally adopts an organic theory, while stating that the transformation of vegetable or animal organic matter in such physical conditions as Nature employs has frustrated all attempts in laboratories to reproduce such a process. The geological difficulty is the conservation of the organic matter by protection from putrefying agents, and this is possible only in waters poor in oxygen, such as exist at the bottom of the Black Sea, which contains so much sulphuretted hydrogen as to make life impossible. This discussion is closed by the conclusion that the origin of oil has not yet been solved with any degree of exactitude, and the further conclusion is that the origin of oil and the primary phase of its migration from the mother rock to its final reservoir have, up to date, been insoluble. While the increase in knowledge of subterranean conditions enables the elimination of many theories, all existing opinions can have only a transitory quality. Therefore there is a vast scope for applied petroleum geology, which, with greater attention to precision in measurements than general geology requires, and with the assistance of applied geophysical instruments and technique, should supply the main clues to the solution of the mystery of the origin and primary migration of oil.

The Memoir closes with 10 pp. on the essential methods and programme of petroleum geological surveys, with a final 4 pp. on the use of the geophysical instruments and technique. B. F. N. M.

118. Structural Evolutions of Southern California. R. D. Reed and J. S. Hollister. *Bull. Amer. Assoc. Petr. Geol.*, 1936, **20**, 1529–1704.—A consideration of the geological history of California indicates that the region was probably affected by three major orogenic periods: (1) Appalachian (Palæozoic), (2) Nevadian (Jurassic), (3) Coast Range Orogeny (Middle Pleistocene). Little is known of conditions prior to the

Appalachian orogeny. This was followed, however, by intermittent subsidence and vulcanism (the Franciscan stage), which culminated in the Nevadian orogeny. The post-Franciscan stage was a period of folding followed by recurrent transgression and regression with minor folding in the late Tertiary.

The Northern Geosynclinal Basin, including the Coalinga district, contains a fairly complete Mesozoic and Cenozoic Series. At the beginning of Tertiary times the basin divided into sub-provinces. Apart from the San Andreas Fault, which forms the western boundary of this basin, the faults, though numerous, are small, and probably of Middle Pleistocene age.

The Northern basin is separated from the Central Geosynclinal Basin by the Caliente Mtns. and the Carrizo Plain. This area is not well known, but has undoubtedly been subjected to faulting and folding movements considerably stronger than those on the other side of the San Andreas Fault. The Miocene is well represented in this province, varying from a mainly non-marine facies in the south-east to a completely marine series in the north-west. The Pliocene is non-marine.

The Central Geosynclinal Basin includes the San Rafael Uplift and the Santa Barbara Embayment, the Ventura Basin forming part of the latter. These features are the result of folding movements at the beginning of the Tertiary, and the Ventura Basin is probably only a remnant of a much larger basin. The Central and Southern Geosynclinal Basins are separated by the structural province of Anacapia.

The Southern Geosynclinal Basin is largely below sea-level, and only the northern part is available for study. In the Los Angeles area it is probable that about 5000 ft. of Upper Cretaceous sediments were deposited and subsequently folded. The Eocene is presumed to occur over the greater part of the basin, but red beds are the only indication of the Oligocene, erosion probably taking place in that period. The Middle Miocene is well developed, and was probably accompanied by faulting movements. Although the area of deposition was restricted, sedimentation in the centre of the basin continued uninterrupted well into Pliocene times.

In the concluding section the authors discuss the problems that arise from this study of the tectonics of Southern California. Despite its small size, it consists of provinces of widely differing mobility, and it is shown that there is a correspondence in history between provinces with similar types of basements. The wider application of this principle is discussed. A similar problem is that of the length of time required for orogenic disturbance, and it is shown that in the Coast Range it was very short, and the data are consistent with the hypothesis that orogeny is not a continuous process. Some light is also thrown on the origin of thrust faults. These seem to be of two types: those developed along lines where thick masses of sediments wedge out, and those developed where the formation of basins caused strong epeirogenic flexures in the early Tertiary sediments surrounding the basin. The data point to there being no dominant direction of thrusting over any great distance.

The paper is accompanied by numerous maps and cross-sections. J. A. G.

119. Geology and Economic Significance of Burma Oilfields. L. D. Stamp. *World Petr.*, 1936, 7 (11), 580–592.—During the Tertiary period this region was a long trough bounded on the east by the Shan Plateau and on the west by the Arakan Yoma. This latter feature was possibly a narrow peninsula or island separating the Burma and Assam areas of deposition. The Burma gulf was sub-divided by a low central ridge now represented by the Pegu Yomas hill range, and all the oilfields have been discovered in the western part. The gulf was open to the sea on the south, but it is probable that several large rivers carried sediments into the northern end. Thus the Tertiary is represented by marine deposits in the south, which gradually give way to deltaic sediments northwards. Sedimentation was occasionally interrupted by lateral folding movements, which caused a temporary deepening of the centre of the basin and a consequent incursion of the sea. These movements resulted in wedges of marine deposits which thin out northwards, but the gradual advance of continental conditions southwards was only temporarily halted. The variation in the lithology from east to west is attributed to littoral conditions which prevailed along the margins of the gulf.

The lateral variation in the lithology has, to a large extent, governed oil accumulation, and also partly explains why the producing horizons do not persist from one structure to another. Also the rapid vertical changes from clay to sands dismisses the possibility of extensive vertical migration, and tends to support the theory that

the oil is indigenous to the beds in which it is found. The Tertiary is divided into Eocene, Peguan (Oligocene–Miocene, mainly marine), and Irrawadian (Mio-Pliocene, mainly freshwater sands). All the petroliferous horizons are associated with conditions intermediate between marine and freshwater.

The production history of the main fields is described, and the paper is illustrated by several coloured maps and sections. J. A. G.

120. New Mid-Continent Shoestring Fields Indicated by Surveys. N. W. Bass and W. R. Dillard. *Oil & Gas J.*, 10.12.36, **35** (30), 36–39.—Recent work by the U.S.G.S. points to the possibility that areas in Osage County, Oklahoma, and in Cowley and Butler Counties, Kansas, may contain oil-bearing sand lenses of Burbank age. They represent beach deposits along the margin of the Cherokee Sea, in *en echelon* arrangement, and are divided into groups separated by narrow gaps where the sand deposit is much thinner, probably old tidal gaps. The depth of the Burbank horizon varies from 2700 to 3000 ft., and although a few wells have been drilled without success, this does not mean that productive lenses will not eventually be discovered. J. A. G.

121. Nebraska's Chances for Finding Oil Improving. K. K. Kimball, *Oil & Gas J.*, 17.12.36, **35** (31), 13–14.—The geology of Nebraska is not very well known, and until more wells have been drilled the chances of finding oil cannot be accurately gauged.

From the Hartville Uplift in Eastern Wyoming the granite dips eastwards to form a deep syncline, rising again to form the Cambridge Anticline in the south-west and the Nemaha Granite Ridge in the south-east. The sediments vary in thickness from about 600 ft. on the latter structure to 9000 ft. or more in the deepest parts of the basin. All the wells drilled so far have been unsuccessful, but it is possible that the surface structures may alter in depth and the wells have not reached the oil horizons at the top of the structures. J. A. G.

122. Stratigraphic Traps Explored for Future Utah Oil Supply. L. G. E. Bignell. *Oil & Gas J.*, 10.12.36, **35** (30), 21–22.—The Uintah Basin contains many indications of oil in the form of seepages, and recent exploratory work has been directed to the search for shore-line conditions around the edge of the basin. East Central Utah is underlain by an extensive Pennsylvanian salt mass, probably the result of the inhibition of an ancient landlocked sea. If the shore-lines or beaches associated with this sea can be discovered, it is hoped that they will be sufficiently extensive to form petroleum reservoirs. Several salt domes in the centre of the basin have been drilled without success. J. A. G.

123. Report on Buena Vista Hills, a Portion of the Midway-Sunset Oilfield. *Sum. of Operations, Calif. Oilfields*, 1936, **20**, No. 4, pp. 3–22.—Rising to a height of about 800 ft., the Buena Vista Hills constitute a chain of hills about 12 miles long by 3 miles wide on the south-western edge of the San Joaquin Valley.

Stratigraphically, the Hills vary in age from Recent surface deposits to the Maricopa Shale of the Monterey. Although no marked unconformity occurs between the formations, periodical erosion appears to have taken place. The surface beds (800 ft. thick) consist of sands, clays, gravels and boulder deposits. Below occur about 1400 ft. of San Joaquin Clays (including the *Scalez* beds), and these are followed by about 500 ft. of Etchegoin Sands. The Monterey Series are then reached, represented by the Santa Margarita (600 ft.) and the Maricopa Shale, of which 1400 ft. has been penetrated.

The Buena Vista Hills are portions of the United and Honolulu anticlines, and although the general structure on the west is a homocline dipping towards the San Joaquin Valley, this feature has given rise to a number of subsidiary anticlines or folds which extend into the valley. They lie in a N.W.–S.E. direction, and are responsible for other productive structures.

The first appearance of gas showings in the Hills occurs just below the Tulare–San Joaquin Clays contact. Commercially productive gas sands are first met with

at 400 ft. above the Upper Salez (Lower San Joaquin), and—followed by oil sands—continue at intervals to the Santa Margarita, which also contains limited amounts of oil sand. From the underlying Maricopa Shale no oil or gas in commercial quantities has as yet been obtained.

Full development of the Hills has still to be undertaken, and untested areas remain which are capable of producing both oil and gas from known formations. Other than the possible exception of the *Mulinia* zone on the S.W. flank, the Type Scalez oil zone extends farther out on the flanks of the Hills than any other productive formations in the area. Possible production from below the present explored depths is now under discussion, the surrounding areas having been made the basis of study in estimating depths and available deposits.

The paper is furnished with a wealth of plates and tables, including contour maps, sections and a production table from 1909 to 1935. G. S. S.

124. Petrographic and Physical Characteristics of Sands from Seven Gulf Coast Producing Horizons. M. T. Halbouty. *Oil Weekly*, 23.11.36, **83** (11), 21–24; 30.11.36, **83** (12), 22–26; 7.12.36, **83** (13), 36–48; 14.12.36, **84** (1), 34–50; 21.12.36, **84** (2), 36–46; 28.12.36, **84** (3), 36–42; 4.1.37, **84** (4), 39–40.—315 samples of Gulf Coast sands were examined to determine the possibility of their identification and correlation on petrographic or physical characteristics. 45 samples were taken from each of the following seven zones: Upper and Lower *MDv* Zone (Lower Miocene), *Discorbis* Zone, *Heterostegina* Zone, *Marginulina* Zone (all Middle Oligocene), Frio (Lower Oligocene), Cockfield (Upper Yegua), and Upper Saline Bayou (Lower Yegua). It was also hoped to find data promoting better understanding of the conditions of sedimentation and stratigraphic relations. Full details are given of the procedure in the examination of texture, shape of grains and mineral composition, and also in the determination of the porosity and permeability of 120 of the samples.

A representative series of histograms shows the results of textural examination by screen analysis, and mention is made of their significance as regards the conditions of sedimentation. The sands of each zone show some peculiarity of grain size, useful in correlation. The Frio sands are markedly different from the other sands, whilst those from the *Heterostegina* zone also have marked characteristics of some diagnostic value.

In shape, the grains are classified as round, sub-round, sub-angular or angular, and expressed as their percentage of the total. The effect of the shape of the grains on porosity is discussed briefly, and histograms and photomicrographs illustrate the results of the studies. Distinguishing features are the large percentage of angular grains in the *Heterostegina* sands, the sharpness and sub-angularity of the *Marginulina* sand grains, and the difference of the Frio sands in containing appreciable amounts of rounded grains. The other sands are similar, with a maximum of sub-angular grains, and a minimum of rounded grains.

All the sands contain similar minerals, but the frequency of a particular mineral varies from zone to zone. Some of the correlative features appear to be general, and some local. The chief features are the absence of tourmaline from Frio sands and its presence in all others, the rarity of muscovite and absence of garnet in all sands but those of the Cockfield and Upper Saline Bayou, the abundance and good development of glauconite in the Cockfield and Upper Saline Bayou, and the presence of titanite only in Frio, Cockfield and Upper Saline Bayou sands, whilst the Frio contains less and the Cockfield more variety of minerals than the other sands.

The permeability and porosity results are tabulated; in a broad way permeability tends to increase with porosity, and also towards the bottom of each zone. The *Discorbis* zone sands show a higher range of permeability than the other sands, and those of the *Heterostegina* zone a lower range, while the Frio sands have higher porosities. Observations are made concerning well-spacing and electric logs.

Throughout the paper it is stressed that more work must be done on a greater number of samples before the many trends established are proved to be of definite correlative and diagnostic value. A. J. H.

125. Rodessa's Outlook. Additional Expansion, Big Recovery and Long Life are Indicated. B. Mills. *Oil Weekly*, 30.11.36, **83** (12), 15–20.—At present the field is

more than 16 miles long, and over a mile wide in places. As it has not been fully defined at either end, and the north flank remains open, it will ultimately cover a wider area. Conservative estimates give an ultimate yield of 230,400,000 brl. of an oil which is 100% paraffin base, with a gravity range of 42–46°. The field should still be regarded as a high-pressure producing area, since the pressure drop from 2700 to 1600–2650 lb. has not seriously affected the flowing status of inside producers.

Production is obtained near the top of the Lower Glen Rose (Lower Cretaceous). 250 ft. of massive anhydrite are underlain by 60 ft. of black shales and broken oolitic lime. This series overlies the first anhydrite stringer, and then the Hill sand, which is the uppermost producing horizon, carrying mainly gas, however. Below it is a second anhydrite stringer, and then the Gloyd (Caddo Levee Board) zone, yielding oil and gas from a maximum thickness of 86 ft. It is separated by an impervious, vari-coloured limestone from the main producing zone, the Dees formation. The entire Dees horizon is less than 90 ft. thick, and is subdivided into the Dees sand, the occasional and principal coquina limestones, and the lower oolitic lime. The porosity of the productive lime formation is comparatively high and uniform. Its maximum thickness is 53 ft., but the average saturated section is much thinner.

Drilling, casing, and production practices are also referred to. A. J. H.

126. **Clark Outstanding Strike of North Mid-Continent.** F. Swindell. *Oil Weekly*, 28.12.36, **84** (3), 21–26.—Several tests have been drilled in Clark County, S.W. Kansas, and have either produced gas with very little oil, or been abandoned, usually on account of drilling difficulties. The completion of a 2358-brl. Viola lime well now opens a large undeveloped area in the S.E. part of the Dodge City Basin, which basin includes most of the western third of the state. Younger Permian beds and post-Permian shales, thought to be of Kiowa age, constitute the surface rocks. Little is known of the subsurface section and structural conditions, on account of lack of exploration and unsatisfactory logs. The log of the deepest well drilled is presented, together with a map showing the surface structural features. Difficulty in drilling straight holes and loss of returns are the chief drilling problems encountered. The presence of the Wilcox sand, as shown in an earlier test, and the discovery of commercial production in the Viola lime establish the area as one of major importance.

A. J. H.

127. **Completely Equipped Laboratory.** F. B. Taylor. *Oil Weekly*, 14.12.36, **84** (2), 48.—The Greysolon Oil Company of Kansas and Minnesota have equipped a laboratory for the investigation of the geologic and productive trends of the area recently acquired for a re-pressuring project. For a successful operation of this area a thorough knowledge of sand characteristics is necessary. All wells are drilled by the percussion system and cored. From each core a sample is broken and wrapped in cellophane for transportation to the laboratory. L. V. W. C.

Geophysics.

128. **Geophysical Prospecting for Oil.** J. C. Karcher. *Min. & Met.*, Jan. 1937, **18** (361), 28, 29.—The use of geophysical methods in oil prospecting exceeded in 1936 any previous year, almost every oil- and gas-producing area of the U.S.A. employing one or more of the methods. Over 10 magnetometer parties, 9 gravimeter parties, 5 electrical surveying crews, 50 torsion balance parties and 200 seismic reflection parties, besides several refraction parties, were operating in the U.S.A. during 1936. The pendulum is being neglected for the gravimeter. Renewed interest in electrical methods is also shown. The magnetometer is used for preliminary work as being much the cheapest. The torsion balance is used as a reconnaissance instrument, but it is desirable to check its surveys by the seismic reflection method before drilling. The refraction seismograph has been nearly eclipsed by the reflection method, owing to the latter's greater precision in measurements of depth. Multiple record is being universally adopted, and there has been an increase in the use of multiple detectors. Seismic reflection has been improved by extending the use of volume control on amplifiers and by the elimination of oil damping in the dynamic elements of the

recording equipment. The art of making seismic reflection surveys in open water and swamp areas has been greatly improved. In California a new photomagnetic analyser has been introduced. The Schlumberger well-surveying method has marked a great increase in use. A wildcat well is scarcely ever drilled in the Texas and Louisiana Gulf Coast area without being surveyed by this method. Geologists find the electrical logs of immense aid in making accurate correlations.

The following are to the credit of geophysical exploration in 1936: 1 new oilfield of major importance and 2 gasfields in California; at least 8 new oilfields in the Texas Gulf Coast area, 1 of major importance; 1 old field discovered on the Gulf Coast in 1935, proved by drilling in 1936 to be of major importance. Several oil- and gas-fields of minor importance in Oklahoma and Kansas. 1 oilfield in Southern Arkansas, 1 oilfield and 2 gasfields in Northern Louisiana and 3 oilfields in Southern Louisiana. There is good reason to anticipate that 1937 will continue to see further rapid exploration. B. F. N. M.

129. Geophysical Prospecting. S. F. Kelly. *Min. & Met.*, Jan. 1937, **18** (361), 26–27.—The Missouri Geological Survey has been very active with magnetometer work on ore deposits, tracing faults and general areal and structural geological mapping. The U.S. Geological Survey has, on a larger scale, been equally busy with resistivity and magnetometer surveys to locate and delimit water supplies in Texas, Nevada and the Hawaiian Islands. In Poland there has been extensive geophysical work going on for the commercial exploitation of oil in the forelands of the Polish Carpathians. The Geophysical Instrument Co. is exhibiting for sale certain standard types of electrical prospecting instruments in Washington. B. F. N. M.

130. Aerial Geologizing Most Important of Applications to Mining Industry. T. Marvin. *Min. & Met.*, Jan. 1937, **18** (361), 20, 21.—The Aviation Committee is reviewing the use of aviation in mining and petroleum operations. At the 1937 Annual Meeting in New York City papers will be presented on the specific Application of Aerial Geologizing, in which aviation is developing to its widest and most technical application. Specialists in aerial photography are extending the scope of the aeroplanes so that small companies and independent prospectors can afford to employ them. The aviation industry is developing the aeroplane to scientific use in aerial mapping. B. F. N. M.

Drilling.

131. Petroleum Industry in U.S.S.R.—Drilling Activity. I. Ganitzki. *Mon. Pet. Roum.*, 1936, **37**, 1735–1737.—From 1821 to 1869 petroleum was obtained in the Baku region from "Persian Wells" (cf. *Mon. Petr. Roum.*, 1933, **34**, 171). The first bore-hole was sunk in 1869, and from this time until the industry was nationalized in May 1920, 3 million metres were drilled in the Baku region, 547,000 metres in the Grozny region, 118,000 metres in the Kouban region with small amounts elsewhere. Progress after the nationalization was slow at first, but from 1924 to 1927 the latest American methods were introduced, notably rotary drilling, up-to-date pumps and compressors. In 1926–27, 308,000 metres for exploitation and 73,000 metres for exploration work were drilled, and in the following year 11,625,400 metric tons of oil were produced. From 1928 to 1932 great attention was paid to refining and to pipe-lines. In all, 2,653,000 metres were drilled, 12·9% of this total being attributed to the deepening of existing wells and 14·7% to work in new areas, the balance being for production purposes. The average depth of wells increased from about 100 metres in 1873 to 770 metres in 1932. New districts exploited were Uzbekistan, Sakhalin, Bachkiria and Perm. Rotary drilling equipment was satisfactory down to 1100 metres, but at greater depths was inefficient owing to the lack of hard alloys for the bit and of adequate pumps, casing, etc. Accidents cost lost time, and in 1935 only 24·6% of the total time was actually devoted to drilling. This compares with a figure of 75% for American practice. In 1936 these difficulties were overcome, mainly by the use of automatic drilling below 1500 metres. The necessary facilities became available and the speed of drilling increased. The average speed per well

per month for the four great Trusts varied from 900 to 820 metres for depths up to 1000 metres, and from 550 to 420 metres for the deeper wells. The cost per metre drilled in 1928–32 was 174 roubles, increasing to 200 roubles in 1933–37.

W. E. J. B.

132. Lining Oil Reservoirs in Wells with Concrete. F. R. Cozzens. *Petr. Eng.*, Nov. 1936, **8** (2), 65.—Concrete is being used 2000 ft. underground in the construction of reservoirs in newly drilled wells. A reservoir of the desired shape and capacity is made at the bottom of the hole by means of a series of well-timed explosive shots and a permanent leak-proof floor is made by using a proper mixture of concrete. As soon as the drill reaches the oil formation the size of hole is reduced and the hole continued through the oil stratum and to 2 ft. below. A shot is then exploded and the well cleaned out and continued shooting carried out until a chamber of the desired size is made. Salt water is used for determining the capacity of the chamber. Concrete is then landed in a bailer until a depth of 6 in. is reached. A different mixture of concrete is then made up and poured into the well until a further 6 in. is made.

L. V. W. C.

133. Development Methods in the Dickinson Field. J. A. Kornfeld. *Petr. Eng.*, Dec. 1936, **8** (3), 28.—The development of the Texas coastal district encounters many physical problems in drilling and completion, since the district is marshy with the water at an average depth of 15 ft. In addition, the coastal tide will affect the depth from 12 to 14 in. The derricks must be set on piles. The slushpits are all on the mainland and the rigs are of the heaviest types. The hole is started at 15 in. and the drilling mud has a weight of 10·5 lb. per gal. for depths down to 7000 ft., and weighting materials are necessary to overcome the high gas pressures encountered. Casing pressures as high as 2450 lb. have been met. L. V. W. C.

134. Power Requirements for Rotary Table in Deep Drilling. W. C. Dreyer and B. H. Berkeley. *Petr. Eng.*, Nov. 1936, **8** (2), 37.—This article gives details and results of a series of tests carried out on a d.c. rig driven by an internal-combustion engine to determine how the load on a rotary table varies with the speed of rotation, the bit pressure and the pump pressure. Charts are given to show how the h.p. input to the rotary table varies with the table speed with different weights allowed on the bit. L. V. W. C.

135. Completing Rotary Wells with Oil. W. A. Sawdon. *Petr. Eng.*, Nov. 1936, **8** (2), 82.—The use of oil in the completion of rotary-drilled wells is one of the methods being followed in several Californian fields, and the practice is adopted in wells the formation pressure of which is very high as well as in those with low formation pressure.

In the Kettleman Hills area, where controlled pressure drilling is carried out, oil is used as the circulating fluid with the definite purpose of procuring data on the productive zones that will lead to more efficient production practice. Drilling in this way also enables any water that may enter the hole to be detected at once.

L. V. W. C.

136. New Apparatus for Securing and Examining Sub-surface Samples of Oil. P. G. Exline. *Petr. Eng.*, Nov. 1936, **8** (2), 116.—Describes a sub-surface sampler and the apparatus used in analysing the samples of reservoir fluid obtained with it.

L. V. W. C.

137. Some Chemical and Physical Considerations Involved in the Cementing of Oil Wells. A. Reid. *J.I.P.T.*, 1936, **22**, 798–802.—A précis of a paper read before the Burma Branch, giving the requirements of oil well cement and the conditions met in use. The factors affecting setting and hardening of the cement are discussed.

G. R. N.

138. Shooting through Casing at 10,000 Feet. Anon. *World Petroleum*, 1936, **7**, 276.—Short article describing the gun perforator and the uses to which it is being applied.
W. W.

139. Improved Equipment for Core Analysis used at Penn. State. T. P. Sanders. *Oil & Gas J.*, 29.10.36, **35** (24), 47.—A description is given of the apparatus for determining the saturation of cores using naphtha and for making tests for permeability.
L. V. W. C.

140. Record String of Pipe Recovered from Gulf Coast, Deep Wildcat. N. Williams. *Oil & Gas J.*, 5.11.36, **35** (25), 57.—A record of deep fishing jobs was recently carried out in the Coastal Louisiana area when a string of 3-in. internal flush-point drill-pipe stuck at a total depth of 11,732 ft. Of this depth all but 825 ft. were successfully cleared. During the fishing a length of washpipe, being used to wash down the hole, became stuck and prevented further recovery. Side-tracking of the stuck pipe was performed.
L. V. W. C.

141. Operations on Bahrein Island Discussed. L. G. E. Bignell. *Oil & Gas J.*, 5.11.36, **35** (25), 46.—The oil in Bahrein Island is found in a soft sugary limestone which is encountered at about 2300 ft. below the surface, the thickness of the producing zone being 325 ft. The wells are spudded to 1500 ft. and then rotary outfits are moved in and the hole completed by rotary. A perforated liner is set opposite the producing section. Well-head pressures of about 475 lb. per square in. are experienced with little gas with the oil and no hydrogen sulphide.

Acid treatment has been performed on the older wells, from 500 to 1000 gallons of acid being used per treatment.
L. V. W. C.

142. A 7000-ft. Relief Well Hits its Mark. K. C. Slater. *Petr. Eng.*, Nov. 1936, **8** (2), 28.—The most recent example of the application of directed drilling to bringing a burning well under control is the Republic Production Co.'s well near Silsbee. The depth of this well was 6982 ft. and the final string was 7-in. casing.

The relief well was located 836 ft. north 70 deg. 17 min. west of the cratered well. This is the greatest distance that a relief well has been located from the well to be killed. Deflection of the relief well was started at 2190 ft. and ten deflecting tools were run. These were nine whipstocks and one Eastman Brewster tool. Eight of the deflecting tools were used before the well had reached 3200 ft., and after that depth the desired direction and angle were maintained by proper drilling operations —that is, by weight on bit, proper speed and pump pressure. Direction was altered by the remaining two tools to enable the drilling tools to reach their objective.
L. V. W. C.

143. Well Spacing. Part I. B. Mills. *Oil Weekly*, 7.12.36, **83** (13), 19.—Two distinct schools of thought exist. One considers that close well spacing will give a maximum recovery of oil, the other favours an extremely conservative programme. Economics must be considered in calculating the number of wells that will give the maximum ultimate recovery of oil. This number will vary from one area to another. From experiments conducted by a number of major producing companies it is shown that well spacing is less important than production methods in the consideration of ultimate recovery. One major company contends that theoretically there is no limit to the drainage area of a well, although the perfect structure does not exist. Production practices definitely affect the ultimate recovery of oil in the three types of structures.
L. V. W. C.

414. Well Spacing. Part II. B. Mills. *Oil Weekly*, 14.12.36, **84** (1), 24.—Regardless of the efficacy of well-spacing programmes, common-sense must be used in handling these problems. This is especially true where the allowables are based upon the number of wells or on well potentials. If the entire field could be operated to give

each operator his exact share of the oil, a well-spacing programme could be based on the amount of oil in place under a lease. Wide spacing has been a success in most fields where it has been tried. The pressure decline has, in general, been slow except where unsound production practices have occurred. The question of ultimate recovery may depend on the action of the wells during the last stages of a field. In low-pressure fields it is possible that close well spacing would be beneficial in giving the greatest ultimate recovery of oil. One well-spacing programme cannot be applied to all fields if maximum recovery of oil is to be realized. L. V. W. C.

145. Spindletop Wells Worked Over by Stanolind to Control Water. N. Williams. *Oil & Gas J.*, 12.11.36, **35** (26), 89.—Encroachment of water, sanding up of wells and other pumping troubles had led to high lifting costs and to the holding up of the output of the field at Spindletop when this area was taken over by Stanolind about a year ago. A study of the field led the engineers to suspect that many of the wells had not been completed at their respective most advantageous structural position. A work-over programme has been undertaken with a view to correcting this situation. One of the principal phases of the work-over programme is to determine structural positions in the sands of all the wells. Directional hole surveys are being made in all the wells. The programme calls for draining the sands with the minimum number of wells and using the widest spacing possible to assure maximum ultimate recovery. L. V. W. C.

146. New Portable Machine being Used to Drill Colorado Test. R. Ingram. *Oil & Gas J.*, 26.11.36, **35** (28), 44.—The drilling machine used on a test hole in East Central Colorado is a combination of some of the features of a regular core drill and of the portable rotary. Two hydraulic jacks with a four-way control valve raise and lower the hexagonal drill stem whilst being driven by a small rotary table. The drill-pipe runs through the inside of the kelly and is made up directly to the swivel and circulating head. A chuck holds the rods in place on the cross-head at the top of the kelly. The entire equipment is mounted on a 4½-ton heavy duty truck, the motor of which drives a power pump set directly behind the cab. L. V. W. C.

147. Progress in Drilling Equipment. Anon. *World Petr.*, 1936, **7**, 274–275.—A review of recently developed drilling equipment. The constant improvement in methods and mechanism contributes to real conservation by reducing waste, increasing production and making available new sources of supply. W. W.

148. Reducing Pressure Drilling to a Science. J. C. Fortune. *World Petr.*, 1936, **7**, 258–264.—Reviewing the past efforts in pressure drilling, extending over a period of 13 years in widely separated portions of the oil world, it is evident that this method is something more than merely a recent development. Where in the past pressure drilling was considered as a last resort, it has now taken a definite place in drilling procedure, and indications for the future point to a continued and wider application, as the search for oil extends deeper and into more difficult formations. The various pieces of equipment used in pressure drilling are described and commented upon. W. W.

149. Cementing at 8800 ft. and 6600 ft. in an Hour. C. P. Parsons. *World Petr.*, 1936, **7**, 266–267.—A short description of a two-stage cement job carried out in one continuous operation in one hour at a well in Texas. 8800 ft. of 7-in. o.d. 30-lb. Grade D, long collared, casing was run through 4700 ft. of 9-in. o.d. casing and 4100 ft. of 8½-in.-diameter open hole, and set with 350 sacks of cement at each stage. Physical factors involved were: high-pressure gas sand located in upper portion of open hole; heavy circulating fluid required to hold down high-pressure gas; "thirsty" formation; high temperature-temperature of circulating mud while drilling was 142° F.; long string of casing; tight hole behind casing. Job was carried out successfully without any difficulty. W. W.

150. Mud Treatment for Heaving Shales. M. T. Halbouty. *World Petr.*, 1936, **7**, 268–273.—The chemical and physical characteristics of heaving shales are clearly described with the aid of diagrams. The former of all heaving shales are singularly based on the presence of the mineral bentonite, which is a hydrous aluminium silicate, and which tends to absorb water from the mud very readily. The physical characteristics of heaving shales are brittle, compact or sticky. The effects of these on drilling are clearly explained, and methods of combating them are mentioned. The author has experienced very good success by the use of chemicals mixed in the circulating fluid to create reactions which produce a definite function while the fluid is circulating in the hole. By this means over 33,286 ft. of heaving shales were successfully penetrated under his direct supervision.

The angle of repose is a big factor in heaving shale conditions, and one of the best methods of minimizing the effect of this is by controlled directional drilling and the use of chemically treated muds. W. W.

151. U.S. Patents. J. C. Stokes. U.S.P. 2,060,352, 10.11.36. Expansible drilling bit in which the cutters are moved into place by means of a plunger operated by the pressure of the drilling fluid.

C. H. Sweet. U.S.P. 2,060,403, 10.11.36. Releasing rope socket.

G. G. Harrington. U.S.P. 2,060,989, 17.11.36. Mounting for roller bit cutters.

E. Bigler. U.S.P. 2,061,057, 17.11.36. Rotary reamer for oil and gas wells.

J. T. Phipps. U.S.P. 2,061,289, 17.11.36. Packer and valve.

J. D. Brack. U.S.P. 2,061,316, 17.11.36. Drill-hole deflector.

J. D. Brack. U.S.P. 2,061,317, 17.11.36. Direction changing drilling device.

R. J. S. Piggott. U.S.P. 2,061,480, 17.11.36. Valve assembly for controlling fluid flow in a well.

J. S. Taylor. U.S.P. 2,061,489, 17.11.36. Well clean-out tool for attachment to the lower end of a bailer.

F. J. Schweitzer. U.S.P. 2,061,852, 24.11.36. Flow bean valve.

W. T. Wells. U.S.P. 2,061,863, 24.11.36. A weight and tension measuring device operated by an extensible and variable resistance element.

W. T. Wells. U.S.P. 2,061,864, 24.11.36. An electrically operated fishing tool.

W. T. Wells. U.S.P. 2,061,865, 24.11.36. A device for educting water from flowing gas wells.

R. G. de la Matex. U.S.P. 2,061,866, 24.11.36. A torque reaction device for drawworks brakes.

R. C. Baker. U.S.P. 2,061,993, 24.11.36. A perforated liner washer.

D. B. Howe. U.S.P. 2,062,058, 24.11.36. An oil well casing pump.

B. J. Weatherley. U.S.P. 2,062,151, 24.11.36. A method for making sub-surface determinations by arranging wave detectors at the surface at unequal distances from the mouth of the well, and operating the drill at the bottom of the well with consequent production of seismic waves. These waves are recorded.

E. H. Leach. U.S.P. 2,062,420, 1.12.36. Inside casing cutter.

W. J. Flury. U.S.P. 2,062,783, 1.12.36. Perforation cleaner and bailer.

R. C. Williams. U.S.P. 2,062,955, 1.12.36. Lower valve puller for pumping strings.

W. G. Lane. U.S.P. 2,062,975, 1.12.36. Gun type casing perforator.

G. A. Hatfield. U.S.P. 2,063,160, 1.12.36. Pump plunger.

J. H. Howard. U.S.P. 2,063,437, 8.12.36. Core catcher for use in a tubular core drill.

J. H. McKenzie. U.S.P. 2,063,821, 8.12.36. Drill pipe float valve.

L. E. Garfield. U.S.P. 2,064,255, 15.12.36. Removable core breaker.

C. N. Scott. U.S.P. 2,064,272, 15.12.36. Period control valve for plunger lift devices.

S. Q. Bates. U.S.P. 2,064,336, 15.12.36. Plug back tool for cementing wells.

L. L. Mackowski. U.S.P. 2,064,552, 15.12.36. A well packer consisting of a tubular packer body and an expansible packing element. Means provided for expanding this packing element.

H. L. McQuiston. U.S.P. 2,064,936, 22.12.36. A method of sealing off porous formations by a sealing medium consisting of an oil carrier and a pulpy substance. Pressure is applied to force the medium into the formation.

R. C. Williamson. U.S.P. 2,064,966, 22.12.36. A well-pumping and flowing mechanism in which a column of liquid is retained in portions of the pipe by a series of valves until the well pressure is admitted to lift the oil.

J. B. Picard and J. C. Bush. U.S.P. 2,065,020, 22.12.36. A fluid activated packing device.

C. E. Huddlestone and M. S. Black. U.S.P. 2,065,135, 22.12.36. Rotary jar.

M. P. Laurent. U.S.P. 2,065,227, 22.12.36. A fluid lift pump in which a string of tubing is reciprocated, the oil and gas valves at the lower end of the string being operated by the reciprocation to admit gas to the pump, when the admission of the oil to the pump is interrupted.

J. T. Barkelew and V. F. Ehrgott. U.S.P. 2,065,261 and 2,065,262, 22.12.36. Rotary jar.

G. E. Cannon. U.S.P. 2,065,512, 29.12.36. A process for plugging off water sands in an oil well by the introduction of a suspension in oil of a solid material inert to oil which swells on contact with water.

C. E. Reed. U.S.P. 2,065,739, 2,065,740, 2,065,741, 2,065,742 and 2,065,743, 29.12.36. Roller cutter and spindle assembly for rotary bits.

W. R. Keever. U.S.P. 2,065,896, 29.12.36. A removable whipstock.

M. S. Black. U.S.P. 2,065,932, 29.12.36. Safety joint for well strings.

L. V. W. C.

Production.

152. Production Practices used in Panhandle. L. G. E. Bignell. *Oil & Gas J.*, 29.10.36, **35** (24), 64.—There are 2892 oil wells in the Texas Panhandle with a combined allowable of 59,485 brl. per day, and of this number 83 are classified as water wells. Practically all wells in this district are produced with some type of power, the old wells being converted to pump jack and some type of multiple pumping unit. These units are some form of back side pumping outfits or central powers. In many cases the wooden derricks are removed and some type of steel mast is erected. Paraffin is a trouble in this area and solvents and heat have been used, but the results have not been completely satisfactory. Many wells have been acid-treated, but shooting with a properly placed charge of nitroglycerin seems to be more successful.

L. V. W. C.

153. 5000 lb. Gas Pressures Controlled in Gulf Wildcat. N. Williams. *Oil & Gas J.*, 5.11.36, **35** (25), 40.—A wildcat test near Houston City showed gas pressures up to 5000 lb., but this high pressure was successfully controlled, although the equipment provided was inadequate for the work presented. The difficulties encountered and the methods adopted to overcome them are fully described.
L. V. W. C.

154. Residue Gas Pressure Used to Elevate Oil from Well Separators to Stock Tanks. L. H. Towers. *Petr. Eng.*, Nov. 1936, **8** (2), 35.—Where conditions require that stock tanks must be placed higher than the separators, it has been the custom either to carry sufficient pressure on the separator to force the delivery of the oil or to elevate the separator on a tower sufficiently high to allow gravity flow.

A system has now been developed that permits the separator to be operated at atmospheric pressure or even vacuum without the necessity of elevating the separator. The principal parts of the set-up consist of a fluid receiver tank in which a float is installed attached to a pilot valve, two three-way diaphragm activated spring-controlled valves, low-pressure regulator and strainer and fittings. The diaphragm valves act as automatic switches, operated by a low-pressure gas system with the pressure applied or released simultaneously on each valve by the action of the pilot valve.

First the receiver tank is filled from the separator, and, second, the receiver tank is discharged into the stock tank line. L. V. W. C.

155. Intermittent Application of Gas is Beneficial in Repressuring. T. P. Sanders. *Oil & Gas J.*, 29.10.36, **35** (24), 42.—Operators in Western Pennsylvania have demonstrated that better results are obtained in repressuring by the intermittent application of gas or air. Increased production is obtained and a smaller input volume is necessary. Although no scientific work has been carried out it is believed that some of the gas introduced into the formation accumulates in the more pervious portions and carries with it very little oil. When the input gas is cut off the pressure in these channels falls to that of the formation and oil is carried into the path of the gas. When gas is reintroduced a large part of this oil is forced to the well.
L. V. W. C.

156. Practices Employed in Completing West Virginia Gas Wells. T. P. Sanders. *Oil & Gas J.*, 5.11.36, **35** (25), 48.—Gas wells in the West Virginia and Kentucky areas are shot practically the entire thickness of the Devonian shale section with a single shot of gelatin. The shot is as much as 800 ft. long, and contains several tons of gelatin. Although there are disadvantages, this shooting increases the production of gas. The average increase in production resulting from shooting is about 50%.
L. V. W. C.

157. Closed Indirect-heating Plant Solves Oil Emulsion Treating Problem in the Luling Field. J. L. Massie. *Petr. Eng.*, Dec. 1936, **8** (3), 44.—A novel application of specially designed heat exchangers has overcome the difficulties encountered in the Luling field in the heating of oil emulsion solution. An indirect method of heating the emulsion was considered the most practical and economical. As much of the 98% of water contained in the emulsion is separated in the field by ordinary settling methods so that about 50% crude and salt water emulsion is delivered to the heating plant. The plant can handle 10,000 brl. of oil emulsion daily. L. V. W. C.

158. Conserving the Gravity and Volume of Crude Oil in the Field. S. F. Mauney, Jr., *Petr. Eng.*, Dec. 1936, **8** (3), 33.—The author discusses a number of methods which, if employed, would result in a marked reduction in crude oil losses. The more usual types of lease losses are dealt with. L. V. W. C.

159. Uniform Pumping Retards Water Intrusion. F. B. Taylor. *Oil Weekly*, 7.12.36, **83** (13), 26.—Tests made in the Ellsworth County area have shown conclusively that

swift pumping results in an increase in water content of recovered fluid. A definite decrease in rate of water percentage increase was noticed when the pump barrel was placed high in the well. L. V. W. C.

160. A Preliminary Investigation of Flowing Wells. Part II. E. Kemler and G. A. Poole. *Oil Weekly*, 30.11.36, **83** (12), 28.—This is the second article dealing with the investigation of flowing wells, and deals with flowing pressures. Formulæ are given, and the examples show their simplicity. Formulæ are derived to give the amount of the available energy resulting from the expansion of gas which is in solution in the oil. L. V. W. C.

161. Problems Involved in Flooding to Obtain Maximum Results. H. M. Ryder. *Oil & Gas J.*, 26.11.36, **35** (28), 48.—Among the problems met with in the recovery of oil by the flooding process are: (1) water supply and treatment; (2) well pattern, spacing and pressure; (3) selection of strata for flooding and means for restricting pressure water to such strata; (4) the physical equipment involved and (5) the raising of the oil and any accompanying water to the surface and their disposition.

These groups are dealt with in detail in the article. L. V. W. C.

162. Corrosion and Pumping Problems Encountered in the Smackover Field. M. Tucker. *Oil & Gas J.*, 26.11.36, **35** (28), 42.—The Smackover oilfield of Southern Arkansas, the sixth largest field in the world, has now resolved itself into one of the most troublesome pumping fields known. With the exception of depth, practically every pumping problem is encountered here. Both sub-surface and surface corrosion are excessive. Sand particles produced with the heavy oil from all four horizons, at high pumping velocities, are harmful to sub-surface equipment and tubing and rod maintenance constitutes the most expensive item of pumping cost. Experimentation has been carried out to enable a proper selection of pumps to be made, and proper counterbalancing has assisted in operating under the larger and more even strokes, resulting in the handling of more fluid. Increased capacities of all equipment when practical are being employed, and closer attention is being paid to the selection and handling of rods and tubing, alignment of surface equipment, etc. Various methods have been tried to reduce as much as possible sub-surface corrosion which shortens the life of mud anchors, pumps, balls and seats, sucker rods and tubing. Loose-fit tube pumps have been used in wells making more than their normal share of sand. L. V. W. C.

163. Salvaging 30,000,000 Barrels of Crude. L. C. Uren. *World Petr.*, 1936, **7**, 240–245.—The relative efficiencies of different secondary methods of recovering crude oil are examined. The methods covered are gas-injection, water-flooding and oil mining. One or more of these secondary oil-recovery methods may eventually find application in every oilfield. W. W.

164. Water Flooding Successfully Used in Oklahoma District. Anon. *Nat. Petr. News*, 8.7.36, **28** (28), 19.—The Bradford principle of increasing the recovery of oil by flooding with water has been successfully used in the north-eastern fields of Oklahoma. No vast campaign of flooding is being undertaken, but the results so far achieved have been good enough to enliven the territory, which is one of the oldest producing districts in Oklahoma. W. W.

165. Important Work Accomplished in Engineering Research. Anon. *Min. & Met.*, Jan. 1937, **18** (361), 31, 32.—This article deals only with those phases of engineering research into the nature of oil reservoirs and production methods. The analysis of cores has become a branch of engineering and geological technique, and its value and importance increased the interest and research work during 1936. Intensive quantitative study of the fluid content of the rock has led to the recognition of the fact that oil-producing rocks usually contain varying amounts of connate water within

the pore spaces, sealed in place by interfacial forces preventing the water moving to the well with the oil. Methods have been devised for reducing the contaminations of the cores by drilling mud, etc.

Reference is made to two outstanding papers on the mechanism of the flow of oil and gas mixtures: (1) by R. D. Wyckoff and H. G. Botset (Abstract 1431 of 1936); (2) by M. Muskat and M. W. Meres (Abstract 36 of 1937). Much work has been done by Lacey, Sage and associates on the thermodynamic properties of the hydrocarbons. Organizations are working on sub-surface samples to determine the saturation pressures, quantities of dissolved gas and the pressure volume relationships of the oil and gas in important fields. The attempts to apply the data obtained to the calculation of the quantity of oil in a reservoir have so far not reached valuable results, but with accumulation of more data, the methods will acquire practical value.

A more widespread use of methods for electrically logging stratigraphical formations has been developed during the past year. The very accurate temperature measurements in wells have been utilized as an index to the character of the formations, the location of water-bearing strata and the position of cement behind the casing.

Studies of pumping wells have resulted in the production of an instrument to furnish a diagram of rod stress and displacement at any position in a string of sucker rods. Work on gas-lift and flowing wells has not made any great improvement in operation. Gas-lift installations are still somewhat crudely made or on the basis of rather invalid theories. The problem of selectively shutting off water without affecting the oil sands is having a great deal of attention, but, so far, the methods proposed have not been generally applied, because probably they need great improvement before adoption in regular practice. Very little work has been done on the difficult problem of evolving a mechanism for the replacement of oil by water in sands.

Research work in petroleum has two major objectives: (1) Conservation of petroleum resources; (2) reduction in costs. The tendency is to shelve the major problems, the solution of which is essential before these two objectives can make substantial progress. More research workers are required who will undertake the solution of the industry's complex problems, which, at present, are being shirked as being too difficult and laid aside to take up the solution of the simpler problems. B. F. N. M.

Transport and Storage.

166. Floating Checks for Gravity Tanks. E. Sterrett. *Oil Weekly*, 14.12.36, **84** (1), 19.—Entrapped air causes trouble whenever a lease tank gravity flow line is forced to deviate from the theoretical ideal of a continuous down-grade from tank to field pump, and many devices are being used to reduce these troubles. One of these devices is a wholly automatic device for shutting off the flow through the line before the oil level has dropped enough to permit air to enter. It consists merely of a wooden ball which is dropped through the gauging hatch and floats on the oil indefinitely. This ball will eventually be drawn down on to the top of the riser, thus cutting off the flow and sealing the line. L. V. W. C.

167. Application of Gas-Engine-Driven Generators for Protection against Pipe-Line Electrolysis. A. H. Blackmore. *Petr. Eng.*, Dec. 1936, **8** (3), 31.—In districts where electricity is not available, gas-engine driven generators have become popular for protection against pipe-line electrolysis. The most economical size of generator is one capable of delivering 60–80 amp. d.c. at a potential of 5 to 10 volts. As much as 5 miles of pipe can be protected by one unit if this voltage and current are properly applied. L. V. W. C.

168. Spontaneous Ignition of Iron Sulphide as a Cause of Oil Fires. *Petr. Times*, 14.11.36, **36**, 619.—The Home Office report on the cause of the explosion in a gasoline storage tank at Salt-End is discussed. It has been stated that iron sulphide will ignite spontaneously in contact with air. An examination of scale removed from many parts of the tank after the explosion revealed the presence of small quantities of sulphide and sulphate sulphur. The water from the Humber, which is used as a bottom in the storage tanks, contains sulphate-reducing bacteria which are known to

survive in water beneath petroleum. A case is therefore argued in support of the theory that the cause of the explosion may have been that iron sulphide on the inside of the tank was disturbed so as to expose, to air in the tank, a fresh surface which, by oxidation, caused an incandescent spot. H. G.

169. Control of Galvanic Electrolyses on Large Diameter Gas Lines. D. Harrell. *Petr. Eng.*, Dec. 1936, **8** (3), 68.—Successful protection from corrosion of a 16-in. gas line in highly corrosive soil was effected in 1930 by placing a metal wrapper of 30-gauge galvanized iron round the pipe and filling it with asphalt to an average depth of 3 in. The sheets overlapped, providing a continuous metal sheath, which was laced round the pipe and couplings with iron wire. No corrosion or leaks have since developed, although large areas were uncoated, while the asphalt showed poor adhesion or bad water absorption. The success was attributed to the cathodic protection given by the galvanized coating, the ends of the pipe outside the coated area being found highly positive to the soil and in bad condition, and the centre portion being protected at its expense. It was therefore decided to continue the coating until a soil of high resistance and low corrosive action was encountered. Success was obtained until this area became corrosive owing to a tidal wave. A further trial was carried out in a highly corrosive area, on a pipe which had been treated with three coats of asphalt paint the previous year. The asphalt was first waterproofed with a layer of grease and the line covered with galvanized iron and wired on. Holes were punched in the coating to facilitate detection of leaks. After one year no leaks had occurred, although some of the zinc coating had been lost. C. L. G.

170. Reconditioning Wyoming-Missouri Crude Line. F. B. Taylor. *Oil Weekly*, 23.11.36, **83** (11), 38.—A line laid by the Stanolind Pipe Line Co. in 1923 is being reconditioned. It is of 12-in. screw pipe throughout, and had a single coating of protecting asphalt where it was evident that corrosive subsoil had been cut. The most extreme cases of line electrolysis were found in a district where backwater had apparently returned through the original ditch considerable distances to promote excessive reaction. One major replacement was the renewal of the river crossing south of the Blue Rapids, Marshall County, Kansas. The new line is being laid half mile north of the old crossing and two 1000 lb. test gate valves are being installed at each side of the river a short distance above high water.

The screw threads are being removed from the old pipe and the ends prepared for welding. L. V. W. C.

171. Two Unusual Installations for Cathodic Protection of Pipe-lines. G. I. Rhodes. *Oil & Gas J.*, 12.11.36, **35** (26), 139.—The costs of cathodic protection of pipe-lines are small compared with the cost of reconditioning. A reasonably well coated single line requires only the ordinary systems of protection. A wind-mill generator is equally applicable to the ordinary or concentrated ground-bed system and to the distributed anode system.

The two installations are coke carbon anodes and zinc rods. Zinc in cathodic protection is new. These systems are fully described. L. V. W. C.

Gas.

172. Formation Volumes and Energy Characteristics of Gas Caps. B. H. Sage and W. N. Lacey. *Oil & Gas J.*, 12.11.36, **35** (26), 176.—An investigation has been carried out to study the properties of mixtures resulting from the re-combination in varying proportions of samples of gas and liquid materials obtained from a surface trap. A detailed investigation of the thermodynamic behaviour of the trap-gas sample was made owing to the dearth of such information. L. V. W. C.

173. Toxic Gases and Their Effect as Lethal Hazards. L. W. Clark. *Petr. Eng.*, Oct. 1936, **8** (1), 33.—An account is given of the toxic or anæsthetic properties of gases encountered in the petroleum industry, with details of the symptoms apparent and treatment advisable. C. L. G.

174. Patents on Gas. J. Y. Johnson. E.P. 457,343, 26.11.36. Gas-washing to remove weak acids by means of an alkaline reacting solution of salts of amino- or imino-acids or tertiary N-acids derived from primary, secondary or tertiary amines containing at least two nitrogen atoms.

J. Y. Johnson. E.P. 457,934, 9.12.36. Manufacture of normally solid paraffin hydrocarbons from CO and H_2 in the presence of a solid catalyst at 50 atm. pressure.

J. Y. Johnson. E.P. 458,035, 11.12.36. Conversion of carbon oxides and hydrogen into gaseous, liquid or solid hydrocarbons or their oxygen-containing derivatives at 200–450° C. The apparatus used is coated with etched iron metal, acting as a catalyst.

National Smelting Co., S. Robson and M. W. Travers. E.P. 458,073, 11.12.36. Recovery of sulphur from sulphurous gases by oxidizing the SO_2 present, separating the SO_3 and H_2SO_4 from the permanent gases and reducing the SO_3 in a single stage to elemental sulphur; hot carbon or carbonaceous material is used as the reducing agent at 500–800° C.

Allgemeine Elek. Ges. E.P. 456,581, 9.11.36. Method of producing fine dispersions of a gas or vapour in a liquid dispersion medium.

Gas Light & Coke Co., W. K. Hutchison and G. Dougill. E.P. 456,661, 9.11.36. Removal of H_2S from gases. W. S. E. C.

Crude Petroleum.

175. Some Notes on Gauging and Testing of Crude Oils. A. H. Richard. *J.I.P.T.*, 1936, **22**, 784–789.—A short paper, with discussion, held at the Trinidad Branch on the expression of quantities derived from a measurement of oil in bulk, a curious hydrometer fault and a suggested tank sampling method. G. R. N.

176. Patents on Crude Oil. E. E. Claytor. U.S.P. 2,060,281, 10.11.36. Breaking of petroleum emulsions by mixing them with an agent containing 65 pts. by wt. of polymerized cotton seed oil and 35 pts. by wt. of polymerized castor oil. W. S. E. C.

Cracking.

177. Present-Day Tendencies in Petroleum Cracking. R. P. Mase. *Refiner*, 1936, **15** (11), 531–534.—The author deals primarily with cracking plant design for operation on topped crude, since, if the design is good, then the plant will handle lighter stocks when need arises. The tube furnace or heater is the most important item of equipment. Development research showed that much higher heat input to radiant tubes and smoother heat transfer could be obtained when in the furnace the flame and combustion gas flow are entirely upward, first along both sides of a centrally located bridge wall, and thence upward through the convection bank. This and other features, such as disposition of the tubes and burners, have largely eliminated hot and cold spots and flame impingement. The tubes can be arranged to obtain a controlled heating curve. This is desirable in two or multicoil cracking, which is a distinct trend at present, when the higher-octane-number gasolines are in demand. Another definite trend is full cracking of the feed, which, owing to better control, does not lead to serious coking troubles. This has brought the reaction chamber back to favour rather than the soaking coil. In heavy oil cracking the liquid products are quickly ejected from the reaction chamber, while the vapours are held under predetermined conditions to complete cracking. The tendency with bubble towers is to operate them at intermediate pressures, *i.e.* between 70 and 120 lb. gauge pressure. The prime movers for hot oil pumps may be actuated by steam, electricity, gas or oil. In the author's opinion, diesel drive is the most satisfactory generally, although gas is frequently the cheapest. The tendency with condensing and cooling equipment is

to instal the open-spray type rather than the box type. Vapour recovery and stabilization units are now integral parts of the cracking plant, and derive heat and absorption oil from the cracking operation to carry out their functions. G. R. N.

178. **Modern Cracking of Californian Crude.** J. C. Morrell, E. F. Nelson, and G. Egloff. *Nat. Petr. News*, 4.11.36, **28** (45), 78.—Full details are given of the operation and yield, together with the properties of charging stock and products, of a modern Dubbs topping and cracking unit. The throughput is at an average rate of 12,600 brl. per day, and the yield of high octane gasoline 63% of crude. The crude is topped by heat exchange with the cracked residuum and separated into light and heavy fractions in the main fractionating column of the cracking system. These fractions are combined with light and heavy reflux condensates respectively, for selective cracking. The unit is running on a blend of Santa Fe Springs and Huntingdon Beach crudes.

Properties of Crude.	Santa Fe Springs.	Huntingdon Beach.
Gravity A.P.I. . . .	24·6	32·8
I.B.P.	162° F.	150° F.
% Distilling at 400° F. .	22·0	30·0
% „ 437° F. .	25·0	35·5
% „ 572° F. .	38·0	52·0
Properties of Topped Crude.		
Gravity A.P.I. . . .	22·2	
I.B.P.	365° F.	
% Distilling at 400° F. .	0·5	
% „ 572° F. .	28·1	

Properties of Products.	Straight-Run Gasoline.	Cracked Gasoline.
A.P.I. Gravity . .	51·9	58·1
I.B.P.	121° F.	92° F.
10% Distilling at . .	201° F.	131° F.
50% „ . .	289° F.	256° F.
90% „ . .	392° F.	364° F.
E.P.	422° F.	402° F.
Octane No. . . .	55	71

An outstanding feature of the plant is its equiflux furnace, representing the latest developments in high and uniform heat input, and in the heating of heavy oil to high temperature without cracking. The cracked distillate is treated by the contractor-centrifuge cold acid-treating process. H. G.

179. **Thermal Decomposition of Propane.** W. Schmieden. *Oel und Kohle*, 1936, **12**, 930.—The cracking of propane at approximately ordinary pressure and under practical conditions was studied in order to derive the optimum conditions for the production of gaseous olefines. The experiments covered the temperature range 650–860° C., and varying reaction periods were adopted.

Optimum results were obtained at 760° C. with 2 seconds reaction period. Under these conditions the volume increase was 90%, of which 72% was gaseous olefines. Soot formation amounted to 1% (wt.) of the original propane. P. G. H.

180. **Stability of Residual Fuels.** A. H. Batchelder. *Refiner*, 1936, **15** (11), 485–492.—Increased gasoline demand has resulted in the cracking of straight-run residue stocks normally utilized as industrial fuels. The tendency is therefore to replace the

latter by cracked fuels made simultaneously with the cracked gasoline. Prejudice against cracked fuels has resulted from troubles experienced with sedimentation and coating of the heaters, which is due to the unstable nature of the fuel. This major disadvantage lies often in the inability of the consumer and refiner to distinguish between unstable and stable fuels. Sedimentation is due to the presence of suspended material in the cracked fuel. This material contains heavy asphaltenes insoluble at ordinary temperatures, but which may dissolve in the fuel at heater temperatures and cause no heater coating. The substance responsible for the formation of heater tube deposits must be insoluble in the fuel at relatively high temperatures, whether already in suspension or formed in the heater. Analyses of the material removed from cracked fuels at 200–300° F. by filtration or centrifuging showed it to be substantially identical with the material deposited in fuel-oil heaters, being benzole insoluble at room temperature. A " Heater Coating Index " was determined by weighing the benzole-insoluble material adhering to heater tubes in 4-day tests. The heaters consisted of tubes (0·7 in. diam.) heated by steam and immersed in about one quart of the fuel changed every 24 hours. Results were reproducible within 10%. Larger-scale tests showed that a deposit of 0·1 in. reduced the heat-transfer coefficient to 39% of that of a clean coil. The effect of addition of gas oil to the cracked fuel is shown in tables and graphs. Straight-run gas oil or excessive amount of cracked gas oil increased the index. Low-aniline-point gas oil addition is preferable to high-aniline-point gas oil, owing to its improved solvent power. Residual asphalts appear to lower the heater coating index and increase the tolerance for gas oil with which the cracked fuel may normally be incompatible. Although the benzole insoluble content is to some extent a measure of the heater coating potentialities of a fuel, the rate of deposition is so dependent on the solvent or protective action of the other constituents that its presence means little more than that coating is a possibility. Under proper conditions, however, the heater test can be used to determine both cracked-fuel quality and the blending characteristics of straight-run fuel oils. G. R. N.

181. Patents on Cracking. Houdry Process Corpn. and T. B. Prickett. E.P. 456,637, 12.11.36. Method of controlling catalytic reactions.

W. Kaplan. U.S.P. 2,059,527, 3.11.36. Improved transfer line in cracking unit for conducting high-temperature cracked vapours from the heating and cracking equipment to the fractionating equipment.

W. J. Hancock. U.S.P. 2,060,306, 10.11.36. Improved tube-still for cracking operations.

E. F. Nelson. U.S.P. 2,060,338, 10.11.36. Improved furnace structure and method of heating in cracking operations.

S. Dayson and J. R. Parten. U.S.P. 2,061,792, 24.11.36. Method of reactivating lighter hydrocarbons in cracking of heavier constituents.

W. A. S. Harmon. U.S.P. 2,061,836, 24.11.36. Cracking of hydrocarbon oils in which a continuously flowing stream of molten metal is passed in a vertical path through the cracking zone. W. S. E. C.

Hydrogenation.

182. Patents on Hydrogenation. Rohm and Haas Co. E.P. 457,358, 26.11.36. Production of alcohols from glycerides by the action of hydrogen in the presence of an unreducing hydrogenating catalyst (oxides of Cu, Cr, and Ba), in the liquid phase at 190–400° C. and under 400 lb. pressure per sq. in. The catalyst is supported on activated alumina. W. S. E. C.

Polymerization.

183. Polymerization, Decomposition, Hydrogenation. Their Common Characteristics. R. Fussteig. *Oil & Gas J.*, 10.9.36, **35** (17), 51.—Results of experiments carried out in an autoclave with ethylene and natural gas, with and without the aid of catalysts

and varying the temperature and pressure, are recorded. The results are used to prove the theory that decomposition, polymerization and hydrogenation of hydrocarbons have in their first phase the same original reaction—a splitting up of the hydrocarbon into free carbon and hydrogen in the nascent state. The carbon in this "potential" form can exist only a very short time under certain conditions, since it possesses the tendency to absorb some "potential" atoms of hydrogen. Carbon with four free linkages or only two free linkages may exist in this state. Only the latter is of importance, and gives rise in reaction with hydrogen to the formation of $:CH_2$ mols. In the moment of saturation of two mutual free linkages the structure is changed resulting in the activation of the other two linkages. The structure may then combine on the free linkage of other $:CH_2$ mols. or with H_2, depending on conditions. The effects of temperature and pressure are very great at this point, as they change the direction of polymerization. With increasing temperatures and pressures the chain of hydrocarbons produced will be longer. The theory is expanded to show the cause of formation of coke and the use of catalysts in influencing reactions in the desired direction. Results of tests are quoted to show the improvement in yield of low mol. wt. unsaturated hydrocarbons obtained by splitting the pyrolysis of natural gas into two stages, viz. (1) transformation of the carbon in the nascent state, (2) composition of the $:CH_2$ mols. followed by polymerization into gaseous unsaturated hydrocarbons. Two reaction chambers, working under different temperature and pressure conditions and with different catalysts, were used.

Since heavy hydrocarbons may be split into $:CH_2$ mols. and free carbon and methane into $:CH_2$ mols. and hydrogen, combination of these two reactions may be used to give higher yields of gasoline fractions and lower coke formation, the free carbon and free hydrogen combining to form $:CH_2$ mols. Such a process consists of arranging for cracked higher mol. wt. hydrocarbon to encounter double-pyrolysis gas in a suitable reaction chamber under selected conditions of pressure and temperature. A flow sheet is provided, and increases in yield of distillate obtained illustrated.

The hydrogenation process is considered to be nothing but the artificial supply of hydrogen in the reaction chamber to increase the production of the $:CH_2$ mols.

R. A. E.

184. Products of Polymerization. C. M. Ridgway, C. R. Wagner, and H. R. Swanson. *Nat. Petr. News*, 4.11.36, **28** (45), 47.—The article deals, in some detail, with the relation of the operating conditions of temperature and pressure and the composition of the gas charge to the composition of the liquid products of polymerization. The production of the aromatic hydrocarbons is promoted by working at high temperature (above 1100° F.) and low pressure (below 300 lb./sq. in.). Data given concerning the operation of a laboratory-scale plant, operated at 250 lb. pressure, show that benzene was first produced at 1100° F. A temperature of 1125° F. was necessary to produce appreciable quantities of toluene, while the xylenes were first detected at that temperature. Other data relating to a semi-commercial plant running on two sources of gas of very different composition indicate that the composition of the liquid products is not changed appreciably by a change in the composition of the gas. This tends to show that the reactions proceed between particular constituents of both gases, the nature and amount of other constituents having little effect on the reactions. Plant-scale experiments have shown that it is not logical to use gases containing large quantities of hydrocarbons of less than 3 C atoms. The elimination of such gases from the charging stock is recommended on the grounds of economy of power, installation and operating costs and the simplification of reaction control. Since the production of polymers depends on the molecular modification of unsaturated bodies, the content of the latter in the charging stock is the factor most likely to influence the particular polymerization process adopted. Where the unsaturateds content is low, two general principles of operation are available. Treatment can be at higher temperatures, whereby polymerization of unsaturateds can proceed simultaneously with the cracking of saturated hydrocarbons. The more logical method comprises three-stage operation, viz. (*a*) high-temperature/high-pressure polymerization of the heavier unsaturateds; (*b*) high-temperature/low-pressure cracking of the heavier saturateds, and (*c*) the high-temperature/low-pressure polymerization of the lighter unsaturateds. Such a process is dealt with at some length. H. G.

185. Polymerization Costs and Yields. J. S. Carey. *Nat. Petr. News*, 4.11.36, **28** (45), 64.—The unitary thermal polymerization process is discussed. The economics of the process depend, in part, on the extent to which uncondensable gas from the first cycle is recycled, the desiderata being the cost of recycling and the replacement value of the gas recycled. Typical operating data are presented in some detail. It is concluded that the process presents no unusual operating problems and permits an on-stream time fully comparable with that obtained with modern cracking equipment. The process can handle, without change in equipment, either entirely saturated or highly unsaturated charging stocks. The product is a high-octane-number gasoline constituent. The yield is from 3·5 to 4 gal. per 10^4 cu. ft. gas charged, and the cost 1·38 to 2·77 c. per gal. H. G.

186. Costs of Polymer Gasoline. E. Ospina-Racines. *World Petr.*, Oct. 1936, **7** (10), 470.—The thermal process operating at high temperature and pressure is capable of simultaneous production and polymerization of unsaturateds, and is therefore more flexible than the catalytic process, which operates at low temperatures and pressures and is applicable only to material containing unsaturateds. These differences naturally affect the cost of production of the polymer gasoline, according to the process used. Another important factor is the composition of the feed, because hydrocarbon gases with only one or two carbon atoms to the mol. theoretically yield far less potential liquid gasoline than those containing 3 or 4 carbon atoms, and, moreover, their efficiency of conversion, calculated as a percentage of the theoretical, by present methods is lower. The conversion of gases from topping crude and recovery systems and cracking still gases is thus more economically justifiable than that of natural gas. The sp. gr. of the product is also of importance, as commercial yields must be calculated on a volume basis. For example, present max. yield of polymer gasoline from butane is 70% by wt., but only 55% by vol., since the sp. gr. of the polymer is 0·74 and of butane is 0·58.

The efficiency of polymer gasoline as an octane rating improver is greater the lower the octane number of the gasoline to be blended. The lead susceptibility of polymer gasoline is nil. In blends with low octane fuels, however, polymer gasoline reduces the amount of T.E.L. required for a given octane number. The bulk of the gasoline sold at present in the U.S.A. has an octane number of 70. Trends of compression ratios, octane requirements and average car age indicate that at present only 15% of present vehicles require 70 octane number gasoline, whereas in 5 years' time at least half the cars in use will require 70 octane fuel, and newer models will require even higher anti-knock fuel. From the economic point of view, polymer gasoline must be regarded as an octane-improving agent, and therefore a direct competitor with other such agents, of which T.E.L. is the only important one at present. A table shows the polymer gasoline and T.E.L. requirements of Penna, Mid-Continent and California gasolines of 49/63 octane number to give 70 octane fuels. With T.E.L. costing 0·26 cent per ml., as at present, and taking 1935 refinery gasoline costs, the max. cost of polymer gasoline to compete on this basis ranges from 6·3/7·12 cents per gal. The rôle of polymer gasoline in conservation of crude is also considered. The article contains some useful tables, including those to show the percentage of the various grades of motor fuel sold, costs of aero and motor fuels on an octane basis, compression ratio of average new car and average octane number of regular gasoline sold in the same year. Possible trends based on consideration of these tables are discussed. R. A. E.

187. Polymer Gasoline. G. Egloff. *Ind. Eng. Chem.*, 1936, **28** (12), 1461.—Three polymerization processes are in operation at the present time, two of these being thermal and the other catalytic.

The first or "unitary thermal process" for the conversion of hydrocarbon gases compressing cracked or paraffinic gases, operates under high temperature and pressure conditions—namely, 960–1100° F. and 1000–3000 lb. per sq. in. Optimum working conditions depend on the composition of the gases processed, the liquids derived being gasoline and gas oil. The gasoline produced has an octane rating of 79 and a blending value of 83 to 92 (50% concentration in reference fuel A3). This process was developed by oil companies known as the Polymerization Process Corporation.

The second or "multiple-coil thermal process," developed by the Pure Oil Company to produce motor fuel from paraffin and olefine hydrocarbon gases, operates under high temperature and "low and high pressure." The working conditions are: temperature 900–1300° F. under pressures varying up to 800 lb. per sq. in. In the first stage of this process operating with a cracked gas-feed stock, temperatures of 900–1000° F. and pressures of 600 to 800 lb. per sq. in. are employed. The residual paraffinic gas from this primary polymerization process then undergoes pyrolysis at temperatures above 1300° F., this step preparing the gas for the final polymerization process. The resulting olefinic gas from the pyrolysis operation is treated at 1150–1300° F. and at a pressure of 50–75 lb. per sq. in. This three-stage process yields gasoline, fuel oil and tar.

The third process is the "Catalytic-Polymerization Process" developed by the Universal Oil Company, which operates on olefine containing gases; the source of these gases may be the cracking process or the catalytic dehydrogenation in cracking of propane-butanes into olefines. The process may be carried out as follows:

1. Catalytic polymerization of cracked or olefine-containing gas at 450° F. under a pressure of 200 lb. per sq. in.
2. Catalytic dehydrogenation of paraffin gases, such as propane and butanes, into the corresponding propene and butenes at about 450° F. and atmospheric pressure, followed by catalytic polymerization.
3. Any cracking of gaseous paraffins to olefines, followed by catalytic polymerization.

Under these conditions gasoline is produced from gaseous olefines and paraffins. The process is mildly exothermic, and the catalyst is of the solid-phosphoric acid type. The gasoline produced has an octane rating of 81–83.

A comparison of the various methods available for producing gasoline from propane and butanes indicates that two stages are desirable: (1) dehydrogenation to produce olefines that readily polymerize, and (2) catalytic polymerization of these olefines. The mildest operating conditions and maximum yields of polymer gasoline are obtained when each of these operations is carried out under its respective optimum conditions in the presence of catalysts. The production of 95–100 octane gasoline can be readily achieved by catalytically polymerizing *iso*butene in cracked gases to di*iso*butenes and then producing *iso*-octane by mild hydrogenation of the di*iso*butenes. H. E. T.

188. Patents on Polymerization. V. N. Ipatieff. U.S.P. 2,060,871, 17.11.36. Polymerization of olefines in the presence of phosphoric acid and a zinc salt.
W. S. E. C.

Refining and Refinery Plant.

189. World-Wide Growth of Refining Capacity. Anon. *World Petr.*, Oct. 1936, **7** (10), 480.—Steady expansion in total capacity, and particularly the increased adoption of combined topping and cracking units, is the significant trend in refinery developments in the U.S.A. in 1936. Polymerization plants are increasing in number, increasing attention is devoted to production of gasoline of 100 octane number, additional solvent refining plants have been built and more natural gasoline plants constructed. The spread of cracking is indicated by the great number of small plants that have installed units during the year. The cracking capacity of existing refineries in terms of total crude capacity amounts to about 90% on the Atlantic seaboard, 65% in Mid-Continent and 75% in California.

Some of the principal new plants of each type are described in detail, and the major developments in other countries are also outlined. R. A. E.

190. Abadan. World's Largest Refinery. *World Petr.*, Oct. 1936, **7** (10), 487.—The total crude oil distillation capacity at Abadan is approximately 270,000 brl. a day. At least half the capacity is in the form of combined topping and vacuum distilling units, the remainder being straightforward topping units. The two latest crude-oil benches are the largest of their class in the world, each having an intake capacity of 65,000 brl. a day and being capable of producing a full range of products from gasoline to pitch. Redistillation units for production of special products and

re-running treated pressure distillate have a capacity of 35,000 brl. a day. All distillation units are connected to a gas-collecting system, and the gas passes to a compression and absorption plant. The gasoline extracted is blended into motor fuels, and the stripped gas, at present used as fuel, will shortly be converted into gasoline.

Iranian crude yields a straight-run gasoline of low anti-knock value, and the heavier fractions contain much wax. Cracking is consequently resorted to, and the cracking capacity of the plant is 90,000 brl. a day of intake. Eight Cross-Kellogg low-pressure plants erected in 1930 are used for naphtha reforming or for production of wax-free gas oil from waxy distillate. Four high-pressure naphtha-reforming units, each of 15,000 brl. capacity, were erected in 1936.

Straight-run gasoline is soda-washed immediately after distillation in order to remove H_2S, and is then sweetened with sodium plumbite in a continuous plant. The plumbite is regenerated. When required, desulphurization is carried out by calcium hypochlorite treatment in a washer of the pressure orifice type, the capacity of which is 1½ million gal. per day. Prior to reforming, naphtha is given a preliminary soda wash in an orifice-type system, having a capacity of 3 million gal. per day, to reduce corrosion of plant. Pressure distillate is given a light acid treatment in a Holley-Mott washer, followed by a soda wash, and is then redistilled at a low temperature in order to minimize corrosion and to yield a product of low gum content. A final soda and hypochlorite treatment is then given in a washer having a capacity of 2½ million gal. per day. Kerosine is refined in an Edeleanu plant capable of handling 800,000 gal. per day. The extract after fractionation and refining is a valuable source of anti-knock material for addition to motor spirit and tractor vaporizing oil, respectively. The kerosine receives a final plumbite treatment to eliminate mercaptans. Gas oil normally requires no treatment, but soda-washing facilities are available if needed. Auxiliary plants for manufacture of acid, SO_2, lime and hydrochloric acid are included. Facts concerning magnitudes of the power-house, pumping plant, storage tanks, staff, etc., are given. R. A. E.

191. N.N.C. Type Cracking in Japan. M. Otaki. *World Petr.*, Oct. 1936, **7** (10), 490.—A cracking unit devised by engineers of the Japan Oil Co. which has been in operation in the Tsurumi refinery since May 1935 is described. The daily capacity is 1500 brl., yielding 45% gasoline under a pressure of 400 lb. Heavy oil for cracking is heated in a cracking furnace, and is led to a reaction furnace at a pressure of 500 lb. The temperature of the ingoing oil is lowered by meeting outgoing oil, and the pressure in the reaction furnace is regulated by a reducing valve at the end. From this valve the cracked oil passes to an evaporator from which light fractions are led to the rectifying column for fractionation into gasoline, light oil and return stock. The heavy oil from the evaporator passes to another tower, and is separated into light and heavy oils. The gasoline produced requires little treatment. The process is used only by the Japan Oil Co., other companies using various American processes. A list of the 77 Japanese refineries and gasoline plants is given, showing location and name of operating company. R. A. E.

192. On the Efficiency of Rectification Column Plates. E. Kirschbaum and C. A. Andrews. *J.I.P.T.*, 1936, **22**, 803-820.—An account of researches at the Techn. Hochschule, Karlsruhe, on the rectification of water-ethyl alcohol mixtures from which it was possible to derive the real or actual efficiency of a rectification plate using the true mean concentration as a basis. G. R. N.

193. Aspects of Refining and Refineries in France. X. Normand. *J.I.P.T.*, 1936. **22**, 821–826.—A lecture on the new market demands and the evolution of refining methods and equipment with reference to their effects on the French oil industry. G. R. N.

194. Rational Utilization of Petroleum and of Petroleum Distillates. V. N. Ipatieff. *Refiner*, 1936, **15** (11), 481–484.—The history of the petroleum industry may be divided into three periods. The first period of development can be called the distillation period, which lasted from the sixties of last century to the beginning of the

World War. During that time chemists began to explore the chemical possibilities of petroleum. The second or cracking period began to develop during and because of the World War. This period has lasted until the present time, and during its tenure vast research programmes on the properties and reactions of hydrocarbons that occur in petroleum have been carried out. The third period we are now entering the author considers is the catalytic period. Already there are existent commercial catalytic processes for the manufacture of chemicals from petroleum and for synthesizing gasoline and lubricating oils, and he believes this field will be considerably extended in the future. G. R. N.

195. **Vapour Re-use Process.** D. F. Othmer. *Ind. Eng. Chem.*, 1936, **28**, 12, 1435.—When it is required to separate by distillation a binary mixture in which the proportion of more volatile constituent is small (*e.g.* 2% acetone in water), the conventional process is very wasteful in heat.

This can be overcome by first processing the liquid in a stripping column, thereby obtaining a smaller bulk of vapour rich in the lighter component. If the stripping column is operated at high pressure, the excess heat in the exit vapour may be used to supply heat to the reboiler of an atmospheric pressure column used to fractionate the vapour from the preliminary stripper into substantially pure components.

The method of application of the system to three-component mixtures is discussed. P. D.

196. **Solvent Recovery with Activated Carbon.** A. E. Williams. *Engineer*, 1936, **162**, 676.—A brief account of the use of activated carbon for the recovery of valuable solvents used in modern commercial processes is presented. Various aspects of the solvent recovery process are discussed, such, for example, as the choice of a suitable activated carbon, the most efficient carbon being the one giving a low permanent retention of vapour, combined with a high absorption capacity. A typical modern solvent recovery plant and its salient features are described. H. E. T.

197. **SO_2 as Naphtha Solvent.** E. Saegebarth. *Nat. Petr. News*, 4.11.36, **28** (45), 76.—By extracting stocks at temperatures as low as minus 80° F. excellent separation of aromatic and olefinic constituents has been achieved. The raffinate is used as lacquer solvent and high-octane-number gasoline. The following data were obtained in a test run on a straight-run cut of 49° A.P.I. gravity and boiling range 200–400° F. Extraction was by counter-current washing with 70% SO_2 at minus 60° F.

	Original Naphtha.	SO_2 Extract.			
		0–100% fraction.	0–33% fraction.	34–66% fraction.	67–98% fraction.
A.P.I. Gravity . .	49·0	34·8	37·2	34·3	32·4
% Vol. Aromatics . .	28·0	86·0	76·0	89·0	93·0
Octane No. . . .	64·5	92·6	88·4	95·5	98·0
Kauri Gum No. . .	49·6	84·5	83·0	85·0	85·5

H. G.

198. **Patents on Plant.** R. N. Shiras. U.S.P. 2,059,494, 3.11.36. Fractionation of wet gases into normally gaseous and liquid components.

C. G. Hawley. U.S.P. 2,059,522, 3.11.36. Improved multi-stage separator and fractionator for oil stills. W. S. E. C.

Chemistry and Physics of Petroleum.

199. Physical and Chemical Properties of Petroleum Fractions. Part II. H. T. Rall and H. M. Smith. *I.E.C. Anal.*, 1936, **8** (6), 436–439.—This part deals with the relations between mol. wt. and concentration in dilute solution. The mol. wt. of oils as usually calculated from freezing- or boiling-point data generally change uniformly with concentration. This necessitates a series of determinations so that the curve through the values obtained may be extrapolated to zero concentration. There appears to be a relation between the slope of the mol. wt.–concentration curve and the value of the extrapolated mol. wt. If this relation is equated with the formula connecting the concentration and mol. wt., a characteristic equation is obtained that will give the value of the extrapolated mol. wt. from one determination. The equation for benzene (cryoscopic) is $M = \frac{m}{1 + 1{\cdot}15C}$, where m and M are the observed and extrapolated mol. wt., respectively, and C is the concentration in gms. of solute per gm. of solvent. The characteristic equation for ethylene dibromide is more cumbersome due to the parabolic relation of M to the slope of the mol. wt.–concentration curve, as compared with a straight line for benzene. Slope–mol. wt. relationships for seven solvents with four petroleum oils are given. G. R. N.

200. Measurement of Flow Rates of Hot Oil Streams. T. A. Mangelsdorf, B. L. Sowers and A. J. Deutser. *I.E.C. Anal.*, 1936, **8** (6), 440–442.—For test purposes the dilution method of measurement is desirable for determining rates of flow of internal re-circulating hot-oil streams on commercial cracking and distillation units. Commercial naphthenic acids have been found suitable for such tests, since its concentration may be determined accurately even in dilute solutions, it is sufficiently stable, non-corrosive and of moderate cost. The method of test was to introduce the acids at a known and constant rate into the stream to be measured and determine its concentration in the flowing stream, sampled at a point sufficiently remote (not less than 50 pipe diameters) for the main and diluent streams to mingle completely. The method of determining the naphthenic acids in the sample was as follows. 100 ml. neutral alcohol and a few drops of phenolphthalein were added to 10–50 gms. sample weighed into a conical flask. The solution was heated and boiled for a few seconds and titrated with 0·1*N*-KOH. Towards the end-point a little water was added to aid in separating the oil from the alcohol. Titration with vigorous shaking and addition of water was alternated until the end-point was indicated by the faint pink colour of the alcohol–water layer. Tests on a commercial cracking unit showed that charge rates determined by this dilution method checked within 2% of the rates determined by tank measurements. Using a dilution concentration of 1% a 20-minute test could be made on a transfer line handling 300 brl. of oil per hour with a consumption of only 1 brl. of naphthenic acid. G. R. N.

201. Free Sulphur in Petroleum Distillates. S. Comey. *I.E.C. Anal.*, 1936, **8** (6), 460–462.—The occurrence of peroxides in sufficient proportion in a gasoline will prevent the copper strip test from indicating the presence of free sulphur. These compounds can be reduced by SO_2, ferrous sulphate in aqueous alcohol and, as the author found, by nascent hydrogen, which, in addition, reduced the free sulphur to H_2S both rapidly and completely. This observation forms the basis of the method described. Synthetic solutions of free sulphur were made up in a naphtha of I.B.P. 135° C. 5 gms. of iron reduced by H_2 (sulphur content 0·03%) were placed in a three-necked flask and the sample of naphtha added. The centre neck was fitted with a stirrer having a mercury seal; the left-hand neck was fitted with a stopper carrying a dropping funnel and a glass inlet tube reaching to the bottom of the flask and connected to a cylinder of H_2 or N_2, whilst the right-hand neck carried a reflux condenser connected to a trap, then a three-way stop-cock, and finally a gas wash-bottle containing a standard solution of ammoniacal cadmium chloride. 40 mls. dilute HCl (1 : 4) were added in several portions through the dropping funnel. Each addition of acid was made after evolution of gas had ceased. After 10 or 15 mls. of acid had been added a precipitate of cadmium sulphide appeared in the gas wash-bottle. After all the acid was added and the iron had dissolved, gas from the cylinder was

bubbled through the liquids in the flask which were heated to about 80° C. The three-way stop-cock was used to take snap samples of the gas to ascertain when the evolution of H_2S had ceased. The cadmium chloride solution in the wash-bottle was titrated with iodine solution in the usual way. The complete test required 20 minutes. To utilize the method for determining free sulphur in gasoline it is recommended to distil off 50% under vacuum from a sample of 200 mls. and carry out the test on the residue. A modification of the method is described when the gasoline contains a dialkyltrisulphide which may occur in the case of an acid-treated product.

G. R. N.

202. Construction of Glass Helices for Packing Fractionating Columns. W. W. Stewart. *I.E.C. Anal.*, 1936, **8** (6), 451–452.—An electrically-driven glass helix winding apparatus constructed from Meccano parts is described which will wind directly a glass spiral with a fibre diameter of about 0·6 mm. and 11 turns per cm. from a Pyrex rod of 2 mm. diameter. Sufficient helices to fill a distilling column having a packed section of 300 ml. can be prepared in 15 hours, which represents a saving of 65 hours over the previous best method. G. R. N.

203. Fluorescent Light Microscopy. C. J. Frosch and E. A. Hauser. *I.E.C. Anal.*, 1936, **8** (6), 423–426.—Since the construction of highly efficient and highly concentrated sources of ultra-violet light, fluorescent light microscopy has proved of increasing interest and value in many applications. It lends itself to the study of typical colloid physical or chemical processes, and permits for the first time visual demonstration of the course of such processes as the production and destruction of emulsions and the influence of different types of emulsifying agents on the stability of the system. It offers a simple, quick and reliable method of determining types of emulsions, which, so far, have been difficult to ascertain. It can be used in the study of wood preservation and in the detection of moulds or fungi. G. R. N.

204. Experiments on Molecular Manifestations. P. Woog. *J.I.P.T.*, 1936, **22**, 831–836.—Experiments are described on the movement of thin films of tristearin, stearic and oleic acids on a water surface. The interpretation of the results and their bearing on the mechanism of lubrication is given. G. R. N.

205. Hydrocarbon Mixtures and Physical Properties. E. Prévost, *Rev. Comb. Liq.*, 1936, **40**, 263–271.—This article describes the variations in physical properties, from those calculated by the simple mixture law, which occur when hydrocarbons of similar or dissimilar constitution are mixed. Properties considered in detail are inflammability (flash point), viscosity and distillation range. The various cases which may be encountered in practice are described and illustrated by graphs. The author concludes that, considering hydrocarbons of the same or similar varieties, it is possible to predict with reasonable accuracy the chief properties of such a mixture. W. E. J. B.

206. Evaporation Rate of Solvents at High Temperatures. F. C. Thorn and C. Bowman. *I.E.C. Anal.*, 1936, **8** (6), 432–435.—A method is described which has been in use for ten years for the purpose of evaluating petroleum solvents employed in the manufacture of rubber cements and compressed asbestos sheet doughs, from which they are subsequently expelled with the aid of heat and air. It differs from other methods in that the air stream is completely saturated, vapour heating is employed, direct reading of the volume of the sample at all stages of evaporation is possible and a large sample is used. 100 c.c. of the sample are placed in a graduated conical centrifuge tube surrounded by a glass jacket through which steam or other vapour is passed downwards. This jacket extends above the centrifuge tube so that a glass air preheater coil can be arranged in the vapour. The lower end of this coil is joined to a capillary tube extending to the bottom of the centrifuge tube. The other end of the coil, after leaving the vapour jacket, is connected to a wet test meter in series with an air supply. After reaching the desired temperature the air stream is turned on at the rate of 300 ml. per minute for gasolines until 25% has evaporated, then increased to 500 ml.

per minute. At intervals the air flow is shut off long enough to take simultaneous readings on the tube and meter. Results are plotted as litres of air (corrected to 21° C.) as a function of the per cent. evaporated. Curves for two petroleum solvents and some paraffin hydrocarbons are given, the latter obtained by computation. Their value as an index of factory performance is indicated. G. R. N.

207. Non-catalytic Addition of Ethylene to Paraffin Hydrocarbons. F. E. Frey and H. J. Hepp. *Ind. Eng. Chem.*, 1936, **28** (12), 1439.—This investigation establishes that paraffin–olefin combination can be effected non-catalytically, and plays a part, sometimes dominant in the conversion of hydrocarbons by heat and pressure. For studying the thermal paraffin–olefin combination reaction, a conversion method designed to permit the alkylation (paraffin–olefin combination) reaction to overshadow the other reactions which may take place, was employed. The olefine used was ethylene and the paraffins propane and *iso*butane.

For the experiments with ethylene and propane, a reaction temperature of 940–950° F. and a pressure of 4500 lb. per sq. in. were employed. Approximately 75% of the liquid products were pentanes, whose formation may be represented by the equation

$$C_2H_4 + C_3H_8 \longrightarrow C_5H_{12}$$

The pentane fraction was composed of about two-thirds *iso*pentane and one-third *n*-pentane, accompanied by a small quantity of pentenes. Consequently it appears that the secondary hydrogen of propane is more readily replaced than the primary hydrogen. Both hexanes and heptanes were produced in substantial amount. Part of the hexanes were formed by the reaction between propylene and propane, whilst the heptanes may have been produced either by secondary alkylation of pentanes with ethylene, or by reaction of butylenes from ethylene polymerization with propane, or both.

In the experiments with ethylene and *iso*butane the chief products were the hexanes, comprising 57% of the liquid product. The formation of hexanes may be represented by the equation

$$C_2H_4 + C_4H_{10} \longrightarrow C_6H_{14}$$

Substitution of tertiary hydrogen by ethyl yields 2 : 2-dimethylbutane, and the substitution of primary hydrogen yields 2-methylpentane. These were the predominant hexanes identified, approximately 80% of the hexane fraction consisting of 2 : 2-dimethylbutane.

The rate of hydrogen replacement in the two reactions given decreases in the order tertiary → secondary–primary, and it is probable that the comparative rates found will indicate what is to be expected in the thermal ethylation of other paraffins.

The heptanes and octanes which form the chief higher products probably resulted both from the direct alkylation of *iso*butane with propylene and other secondary reactions.

A discussion is given of the chemistry and thermodynamics involved in these experiments. H. E. T.

208. Heat Transfer and Pressure Drop of Liquids in Tubes. E. N. Sieder and G. E. Tate. *Ind. Eng. Chem.*, 1936, **28**, 12, 1429.—Data are presented on heat transfer to three oils of widely different viscosities flowing in a 0·75-in. tube under viscous flow conditions. Both heating and cooling were used. The results are correlated in terms of main stream properties by a method which takes into account the viscosity gradient of the fluid in the tube by the introduction of the term $(\mu_a/\mu_w)^{0.14}$, where μ_a is the viscosity of the fluid at the main stream temperature and μ_w that at the wall. The formula was then further tested against the results of other investigators. The above term can be retained in the equation of the Nueselt type used for correlating data in turbulent flow, and results in better agreement between heating and cooling runs.

In addition to the effect which the viscosity gradient has on heat transfer rate, there is also an effect on the friction factor to be used when calculating pressure drop. This can be allowed for by means of a graph connecting f/f_{iso} (where f = actual friction factor, and f_{iso} = isothermal friction factor) and μ_a/μ_w. Such a graph is given covering both the viscous and turbulent regions. P. D.

209. Constitution and Viscosity of Liquids. G. Hugel. *Oel und Kohle*, 1936, **12**, 917–920.—Pure polycyclic aromatic and hydro-aromatic hydrocarbon liquids have been observed to have very steep viscosity temperature curves for which molecular association is advanced as an explanation. The structure of such molecules enables them to join end to end by means of residual valency to form complexes which are stable at low temperatures. The introduction of side-chains (*e.g.* $C_5H_{15}\beta$) into the molecule (*e.g.* anthracene) prevents the molecules from getting near enough for association to occur. Substances of this nature are shown to have good viscosity curves.

Experiment showed that the addition of certain types of molecule to a hydrogenated coal-tar product materially improved the viscosity curve. The added material, which should itself contain two C rings, prevents dissociation of the complex on warming by strengthening the intermolecular linkages. Only a few per cent. of "dope" is necessary to produce an effect on the viscosity curve. The results as a whole indicate that the molecules of hydrocarbon liquids of the type under consideration are not distributed in an entirely random manner. The known effect of mechanical treatment in decreasing the viscosity of solutions of high-molecular-weight substances was further examined. The viscosity was measured before and after forcing the solution (tetralin as solvent) through a No. 3 Schott glass filter plate. A solution of a "polyprane" (mol. wt. 50,000) showed a marked fall in viscosity.

A 10% solution of another polyprane (mol. wt. 6000) in a lubricating oil, with or without addition of tetralin, also decreased in viscosity after passage through the filter. Neither the polyprane nor the oil, however, was affected when treated separately. P. G. H.

Analysis and Testing.

210. Determination of Analytical Data from Specific Gravity of Mineral Oils. M. Marder. *Oel und Kohle*, 1936, **12**, 1061, 1087.—A study of the relationships between the density at 15° C. and other properties of petroleum oils, *e.g.* calorific value, C : H ratio, and ignition properties. The work was based on analytical data obtained by the author and on the published results of Constam and Schlapfer (*VDI-Zeitschrift*, 1913). When plotted against d_{15} the calorific value of all kinds of oil (with the exception of one cracked oil), irrespective of origin, did not deviate by more than $\pm$ 40 kg.-cals. from a mean straight line.

It is suggested that the calorific value may be obtained directly from the hydrometer gravity with sufficient accuracy for most purposes. It is necessary to deduct 70 kg.-cals. for each 1% sulphur present in the oil.

By the same method the elementary composition (C and H content and C : H ratio) may be derived with considerable accuracy from specific gravity. Although C content is not consistently $\propto d_{15}$, C and S deviate only slightly from a mean straight line plotted against d_{15}. Since the sulphur content is assumed to be known, C content may be obtained to within 0·3%. The cetene number of diesel fuels may also be determined directly from hydrometer gravity, provided that the "mean boiling point" of the fuel is taken into account. P. G. H.

211. Extinction Values of Mineral Oils. R. Kootschau. *Oel und Kohle*, 1936, **12**, 992.—The author claims priority for much of the subject-matter of a recent article by H. Siebeneck. (See Abstract No. 1482, 1936.) P. G. H.

212. Paper No. 12—Danish State Road Laboratories. Anon. *Asphalt und Teer*, 1936, **36** (51), 1017–1021.—This paper gives an account of the activities of the laboratories in 1934–35 and includes a description of a method for cold extraction of bitumen from asphalt. A. O.

Motor Fuels.

213. High Anti-Knock Fuels from Lower Olefines. S. F. Birch, F. B. Pim, and T. Tait. *J.S.C.I.*, **55**, 335T–337T.—The production of $\beta\beta\delta$ trimethylpentane (*iso*-octane) by the hydrogenation of diisobutene has encouraged attempts to produce

hydrocarbons of the same type having similar high anti-knock values. The formation of hydrocarbon polymerides by the action of sulphuric acid on aliphatic secondary and tertiary alcohols is well known, but it has now been shown that, under certain conditions, condensation products, involving the olefines corresponding with the alcohols taken, are also obtained. Thus, from a mixture of tertiary butyl and amyl alcohols there is obtained, together with polymerides, a product derived from both *iso*butene and trimethylethylene—an *iso*nonene. This apparently new reaction has been utilized to prepare α-*iso*nonene (and diamylene as a secondary product) from *tert.*-butyl and *tert.*-amyl alcohols, β-*iso*nonene from *sec.*-butyl and *tert.*-amyl alcohols, and ββγ-trimethylpentene from *tert.*- and *sec.*-butyl alcohols. Experimental data are given for all the preparations. Reactions involving secondary alcohols require more drastic treatment than those involving tertiary alcohols only, and the resultant product appears to be more complex, hence the separation of the required hydrocarbon is rendered more difficult.

The octane number and blending value of these olefines have been determined by the C.F.R. Motor Method. The olefines have also been hydrogenated to the corresponding paraffin and similar knock ratings determined. The method of hydrogenation is briefly mentioned as being in the vapour phase over a supported nickel catalyst under the mildest conditions possible. The knock ratings and blending values have been tabulated, the values for 100% hydrocarbon being as follows: α-*iso*nonene 74·8, α-*iso*nonane 98·0, diamylene 73·6, *iso*decane 94·8, β-*iso*nonene 83·5, β-*iso*nonane 94·0, ββγ-trimethylpentene 85·6, ββγ-trimethylpentane 100·2. In the case of the olefines it was observed that the blending value was relatively high at low concentration and depreciated with increasing concentration. The blending curve of diamylene is remarkable, a 60% blend in a low octane base being slightly better than the pure olefine. Some doubt is expressed regarding the purity of the ββγ-trimethylpentene.

T. C. G. T.

214. Motor Fuel from Catalytic Treatment of Cracked Gases. G. Egloff. *Refiner*, 1936, **15** (11), 524–528; *Oil & Gas J.*, 15.10.36, **35** (22), 58.—The U.O.P. catalytic polymerization unit consists of a heater, catalyst chambers, condenser, receiver, stabilizer and equipment for reactivating the catalyst *in situ*. The cracked gas heated to about 450° F. and at 200 lb. pressure is passed through the catalyst towers containing "solid phosphoric acid" catalyst under such conditions of time, temperature and pressure that the polymer products obtained boil with the gasoline range. A small quantity of steam is continuously added to the gas to prevent dehydration of the catalyst. The polymer gasoline is condensed and stabilized, whilst the exit gas from the receiver and the stabilizer goes to refinery fuel gas. The catalyst loses its activity owing to deposition of carbonaceous material. Regeneration is accomplished by first oxidizing the deposit by means of flue gases containing controlled amounts of oxygen and water vapour then hydrating the catalyst in an atmosphere of steam for 10 to 16 hrs. at 500° F. The yield of polygasoline per 1000 cu. ft. of cracked gas is greater the higher the propene–butene content, and is also larger if more butene than propene is present; a 14·1% and 41·0% content of C_3–C_4 unsaturates gave yields of 2·4 and 9·2 U.S. gal. per 1000 cu ft., respectively. Polygasoline is composed of relatively few hydrocarbons, and these are predominantly olefinic. The sulphur content of the product depends on the amount of H_2S in the cracked gas. Removal of the H_2S before polymerization is generally advisable. The octane number of polygasoline varies around 79–82, and its blending octane number is 95–125, according to the octane number of the gasoline to which it is added. When the *iso*butene concentrate of cracked gas is passed over the catalyst technical di*iso*butene of octane number 84 is obtained. This product on mild hydrogenation gives technical *iso*-octane of octane number 95–100.

G. R. N.

215. Influence of Automobile Design on the Use of Natural Gasoline. A. C. Moore and R. I. Stirton, *Oil & Gas J.*, 19.11.36, **35** (27), 49.—Advantages obtained by using increased quantities of natural gasoline in motor fuels are ease of starting, rapid warming-up, flexibility of operation, decreased detonation and better acceleration. The major objection to this increased usage is the tendency to cause vapour lock.

Results of co-operation between the industries, with a view to avoiding vapour lock, are reviewed. One important factor is the reduction in fuel-line temperature, and it is shown that from 1930 to 1935 these temperatures tended to increase in the average new car under identical conditions of driving. This was probably due to changes in design, increased streamlining, etc. The average 1936 car shows a decrease of about 10° F. in max. fuel system temperatures compared with the 1935 car. Another important factor influencing vapour lock is the limiting vapour to liquid volume ratio which can exist in the fuel system without disturbing the delivery of liquid fuel to the main jet. In this respect cars of previous years still being used play a very important part. Prior to 1930 many cars with vacuum tanks showed a vapour–liquid tolerance of nil, whereas for 1930 onwards Bridgeman and others have shown all cars tested to have a tolerance of 10 min. and a tendency to average about 20 is indicated in 1935 and 1936. Using the method developed by Barber and Kulason, calculation has been made of the max. permissible volatilities and vapour pressures of summer and winter gasolines for use in (*a*) cars manufactured in 1936, and (*b*) cars in use in 1933 (*i.e.* including cars made before 1930).

The results are graphed and compared with typical commercial grade sold in summer and winter, respectively, of 1936. A considerable permissible increase in front-end volatility of typical commercial is shown to be possible for all cars, but the greater tolerance of the 1936 car is also clearly indicated. This improvement has been achieved by venting the vapours formed in the fuel system to the atmosphere. In order to form some estimate of the probable loss of gasoline which occurs, a special laboratory apparatus was designed with fuel pump, heaters, vapour vent, etc., to imitate a fuel system and carburettor. The properties of gasolines before and after passing through the apparatus were examined, and it was found that a fuel matching the max. permissible volatility range calculated for 1936 cars in the winter suffered a loss of about 40% greater than a fuel matching the corresponding 1933 range. Octane ratings fell by 2 and 1 numbers, respectively. Typical commercial gasolines of the present day were not subject to more than half the losses of these highly volatile products. The marketing of gasolines having considerably increased "front-end" volatility is thus possible from the point of view of freedom from vapour lock. This will result in advantages already mentioned, and if the increase is gradual, the resulting decrease in economy will probably not give rise to extensive complaints from the public. Should the present trend in sales promotion to stress economy of operation continue, however, then the automobile designer will be driven to reduce fuel system temperatures. R. A. E.

216. Correlation of Car and Fuel Vapour-Locking Characteristics. E. M. Barber and B. A. Kulason. *J.S.A.E.*, 1936, **39**, 351–355.—This paper describes the production of a chart for indicating the vapour-locking tendencies of gasolines. The major factors involved in this problem are: (1) the tendency of the gasoline to boil and form vapour in the fuel supply and metering system, and is described by a curve showing the quantity of vapour formed, plotted as a function of the temperature; (2) the temperature and pressure to which the gasoline is subjected in the fuel supply and metering system; (3) the vapour tolerance of the fuel system, which specifies the maximum volume of vapour that can be obtained from the gasoline in passing through the fuel system without interfering with engine performance—this is expressed in terms of vapour to liquid volume ratio; (4) special tests are required to determine vapour-locking tendencies of gasolines, and the chart described was developed from experience obtained in a special variable-vapour-volume barometer type of vapour-pressure apparatus. By means of the chart it is claimed that vapour-locking properties can be predicted from the Reid Vapour Pressure and A.S.T.M. distillation curve. A curve is also given to obtain approximate corrections for the effect of different pressures. The method for obtaining car vapour-locking properties is mentioned. Fuel system losses by venting are discussed; losses of 2% and 5% are not uncommon, and even 10·5% has been encountered under fairly normal conditions, although still without indication of vapour lock. This means not only decrease of fuel economy but deterioration of 2–3 octane numbers in the fuel as supplied to the engine. A table is given describing the vapour-locking properties of several cars, and also a curve is given showing gasoline losses from the fuel systems. W. A. W.

217. Precision of Knock Rating. D. B. Brooks. *J.S.A.E.*, 1936, **39**, 22–24.—An analysis of the ratings obtained on a large number of fuels (99 in all, comprising over 2000 tests) shows the average error to be just under ½ octane unit. It was noticed that straight-run, cracked, leaded fuels, and blends of straight-run and cracked, showed practically the same experimental errors in rating, whilst undoped cracked fuels showed greater divergencies, and benzole blends the highest differences of any of the fuels under review. C. H. S.

218. Relation between Evaporation and Detonation in Motor Fuels. O. Herstad. *Oel und Kohle*, 1936, **12**, 1014, 1111.—The author considers that tendency to detonation is related to rate of evaporation at temperatures prevailing in the different parts of the combustion chamber. An apparatus is described for comparing fuels with respect to evaporation behaviour. The time is found for 1 c.c. to evaporate completely from a hot copper surface, capable of being heated at a number of constant temperatures up to about 200° C. It was found that a number of knock-resistant fuels showed a sudden and marked *decrease* in rate of evaporation when a sufficiently high testing temperature was selected. This is explained on the grounds of "spheroidal state." The experimental results deal chiefly with ternary mixtures of benzole, benzine and alcohol, which were found to assume the spheroidal state at certain temperatures below 200° C. It is concluded that at the moment of sparking the fuel is present partly as a gas and partly as liquid droplets, and on this basis the author explains certain discrepancies which are not accounted for by Ricardo's view that the combustion is entirely a gaseous reaction. In particular, it is explained how tendency to detonation is lessened by pre-heating the fuel gas mixture. P. G. H.

219. Thermodynamic Properties of the Working Fluid in Internal Combustion Engines. R. L. Hershey, J. E. Eberhardt and H. C. Hottell. *J.S.A.E.*, 1936, **39**, 409–424.—The authors claim that in spite of the inherent complexity of the problem it is possible to present an exact graphical picture of the thermodynamics of an internal-combustion engine. Charts are given showing the thermodynamic properties of the air-fuel mixture and residual products of combustion before that event. The properties of the equilibrium mixture after combustion are also given graphically. Allowances have been made for variations of specific heats with temperature and for dissociation after combustion. The graphs also show the effects of operating variables. C. H. S.

220. Naphtha-Type Tractor Fuels. A. S. James. *Nat. Petr. News*, 4.11.36, **28** (45), 19.—It is stated that there is an increasing tendency for tractor operators to use 70 octane number gasoline in place of the usual heavier distillate. The article concerns itself with a discussion of the economics of the change-over. It is claimed that the advantage to the user is such that an increase of 75% in the price per gallon of fuel would be justified. The saving in oil costs due to the reduced dilution which occurs with gasoline represents 2 cents per gallon of fuel, and engine wear is stated to be 3·5 times heavier with distillate than with gasoline. On the refiner's side the cracking to gasoline of displaced distillate and its treatment to 70 octane fuel involves a cost of 2 cents per gallon. Hence, from this standpoint, 70 octane fuel for tractors should command at least 2 cents per gallon more than distillate. The article also deals briefly with tube corrosion and gum inhibitors. H. G.

221. Theoretical Considerations on the Manufacture of Petroleum Spirit. H. Weiss. *J.I.P.T.*, 1936, **22**, 779–783.—A general paper dealing with the progress and development of methods of making gasoline and their relation to the principles of theoretical chemistry. G. R. N.

222. "Agrol" Gasolines. W. T. Ziegenhain. *Oil & Gas J.*, 17.9.36, **35** (18), 38.—With a view to ascertaining whether alcohol–gasoline blends can be manufactured and sold economically in the U.S.A., Chemical Foundation of Kansas Co. are commencing the sale of three grades of such blends under the name of Agrol. An idle alcohol plant

at Atchison, Kansas, is being remodelled and equipped to produce 10,000 gal. a day of absolute alcohol from a variety of farm products, and the cost of manufacture from each product will be carefully investigated. The "Agrol" fluid to be marketed to filling-station operators will consist of approximately equal parts of a selected gasoline and alcohol plus denaturant. The grades sold to the public will be known as "Agrol" 5, 10 and 15, indicating anti-knock values equivalent to those of 5, 10 and 15% respectively of alcohol in mixtures of alcohol and 60 octane Mid-Continent gasoline. The operator can thus select his own basic gasoline and add "Agrol" fluid in the quantities necessary to equal the required standards. R. A. E.

223. Patents on Motor Spirit. Bataafsche Petroleum Mij. E.P. 457,997, 10.12.36. Refining of distillates obtained from cracking or hydrogenating of oils by treating them in the liquid phase at 200–400° C. with a phosphoric acid catalyst deposited on a solid carrier.

Standard Oil Development Co. E.P. 456,958, 18.11.36. Solvent extraction of lower-boiling hydrocarbons with ethylene, diethylene or triethylene glycol at 50–150° F.

A. L. Lyman. U.S.P. 2,060,091, 10.11.36. Removal of sulphur compounds from motor spirit by passing the spirit vapours through a bed of finely-divided clay at 550–750° F. and under a pressure of 50 lb.

A. B. Pierce and A. W. Trusty. U.S.P. 2,060,112, 10.11.36. Cracked petroleum or naphtha is treated with cadmium sulphide as catalyst at 600–700° F. in a contact zone. The condensate is washed with alkaline solution to remove H_2S.

W. M. Malisoff and F. C. Hess. U.S.P. 2,061,583, 24.11.36. Refining of gasoline with pyrophosphoric acid and phenol or cresol at 150–300° C.

J. C. Morrell. U.S.P. 2,061,845, 24.11.36. Refining of sulphurous hydrocarbon distillates in the vapour phase by means of a hydrogen-containing gas and a catalyst, *e.g.* molybdic acid, sodium aluminate. W. S. E. C.

Lubricants and Lubrication.

224. Chemical Constituents of Lubricating Oil. F. D. Rossini. *Refiner*, 1936, **15** (11), 499–506.—An account of the work of the A.P.I. Research Project No. 6 on the constituents of the lubricating oils and the methods for separating the desirable constituents. 67 kgms. of a Mid-Continent lubricating fraction (d/100° F. 0·87–0·91; V.I. 75–90) were extracted with SO_2 and the raffinate dewaxed with $C_2H_4Cl_2$ at − 18° C. and treated with silica gel; the yields were 17–9 kgm. SO_2 extract (d/100° F. 0·95–1·07; V.I. − 150 to − 300), 20·3 kgm. wax (d/100° F. 0·80–0·83; V.I. 125–150) and 19–8 kgm. water-white oil (d/100° F. 0·85–0·88; V.I. 90–110). The last product was submitted to fractional distillation under high vacuum to give light and heavy end fractions and 10·1 kgm. of middle fractions of substantially constant boiling characteristics. These middle fractions were separated by reflux extraction with acetone in 46-ft. glass columns into about 600 fractions of water-white oil, each presumably composed of molecules of similar size and type and each representing about 1/4000 part of the original lubricating oil. Thirty of the fractions were selected as key fractions, and their physical properties determined and compared with the corresponding properties of pure hydrocarbons of the same mol. wt. and composition. The following conclusions were reached.

(1) Of the fractions of lower mol. wt. (about 28 carbon atoms per molecule), the least soluble (raffinate) fractions consisted substantially of one ring naphthenes and the more soluble fractions of two ring (and some with three) naphthenes;

(2) Of the fractions of higher mol. wt. (about 37 carbon atoms per mol.) the least soluble fractions consisted substantially of two ring naphthenes and the more soluble fractions of naphthenes with three (and some with four) rings per mol.

(3) The most soluble fraction in each series appeared to contain some unsaturates and a considerable amount of one ring aromatics.

(4) No evidence was found for the presence of iso or branched chain paraffins in the water-white oil.

From this it may be concluded that a solvent extracted and dewaxed Mid-Continent lubricating oil contains no paraffins, and is made up principally of naphthenes with from one to five rings per molecule together with appropriate paraffinic side-chains. G. R. N.

225. Susceptivity of Mineral Lubricating Oils in Use. S. J. M. Auld. *J.S.C.I.*, 1936, **55** (51), 1014–1020.—The arbitrary tests which have been designed to assess resistance to oxidation are claimed to give some insight into the chemical nature of the lubricating fractions of petroleum. The old classification based on the type of residue left after distillation, *i.e.* naphthenic, paraffinic and asphaltic, is misleading; for the facts seem to be that all mineral lubricating fractions, from whatever source, are built up of compounds containing paraffinic or *iso*paraffinic, naphthenic (with differently numbered rings) and aromatic nuclei or groupings; that none or few of these compounds contain only one kind of grouping, and that the difference in behaviour of the viscosity-carrying hydrocarbons is due to the proportion and distribution of these groupings.

The naphthenes and poly-naphthenes are believed to be mostly, if not wholly, five- or six-membered rings, and further aromatic nuclei are considered possibly little more complex than naphthenic. Attention is directed to the fact that synthetic multi-membered rings are non-viscous and relatively unstable. Hugel's conclusion from work on synthesis is quoted, "cyclization is the chief factor affecting viscosity"; similarly Mikeska, "Viscosity Index is improved by lengthening the side chain and on this property straight chains have more effect than branched chains." Then follows speculation on likely types of chemical structure of lubricating oils from the three conventional types of crude oil. In service lubricating oils crack if heated sufficiently, or acidify if oxidized severely. Decomposition products may be solids, *e.g.* carbon, or soluble materials capable of peptizing solid matter, and conditions are set up well suited to absorption at an aqueous interface. Thus from used turbine oils low-mol.-wt. acids, *e.g.* formic, acetic and caproic, have been isolated, and these aggravate emulsion troubles by the formation of iron soaps. It is considered likely that the aliphatic chains, particularly branched chains with tertiary carbon, are responsible for the splitting off of the fatty acids, and that since the formation of such acids is more likely from the so-called paraffinic oils, and since all types are considered to have some, at any rate, aliphatic groupings, then it is likely that groupings exist which are preferentially oxidized, and so protect the aliphatic groupings. Such protective groupings could be removed by erroneous or excessive refining. Condensation to asphaltic and resinous solids may be the result of cyclization by removal of hydrogen or as simple or mixed anhydrides or lactones. In practice, a balance is struck, and by suitable choice of crude source and method and extent of refining, oxidation proceeds along the lines of the formation of high-mol.-wt. oil-soluble acids which largely remain as such, do not induce sludging and have no great tendency towards polymerization. Neutralization value alone is no measure of the condition of turbine oils. Rate of change of acidity or oxidation is often more important than actual magnitude. At high temperatures the mechanism of the reaction is even more obscure. The probable courses and results are indicated for the various types of hydrocarbons, and the conclusion is reached that by cracking little or no carbon is formed by direct splitting, but that this is the result of progressive enlargement of the molecule on one side of the heat action. The lowest temperature at which cracking dehydrogenation is known to occur is 260° C., and although in a fast-moving engine the main oil film by continual replacement is below this temperature, yet the oil trapped in and behind the piston rings will definitely be exposed to cracking temperatures, and, if it cracks easily, stuck rings will result. It is considered that oxidation plays some part, and proceeds via hard, insoluble, resinous hydrocarbons to asphaltenes, carbenes, carboids and ultimately to coke. It is claimed that solvent refining, by increasing the paraffinicity, produces oils in which the aliphatic groupings determine the good behaviour. Graphs are given illustrating the resistance to oxidation of such oils as determined by the Air Ministry Oxidation test carried out, however, at the elevated temperature of either 230° C. or 240° C. The mechanism of sludging of crankcase oils is briefly discussed, and mention made of the work of both King and

Redgrove on oxidation lubrication. Finally, reclamation of used oils is considered, and results and comments are given of oxidation tests by the Air Ministry Method, including figures on asphaltenes after oxidation on used oils, both untreated and treated by four different methods. J. L. T.

226. **The Newer Bearing Materials and their Lubrication.** H. G. Mougey. *Refiner*, 1936, **15** (11), 493–498; *Oil & Gas J.*, 19.11.36, **35** (27), 39.—After a short historical introduction, the author states that two theories exist as to the nature of a rotating bearing. One is that a bearing must be a combination of hard crystals in a softer matrix. The second theory, which is preferred by the author, is that the bearing material must have a combination of properties the net effect of which will make it serviceable. These properties are mechanical strength, bonding characteristics, melting point, fatigue resistance, anti-friction characteristics, non-scoring characteristics, conformability, embeddability and corrosion resistance. The particular combination will depend on the forces applied, *e.g.* leaded bronze is excellent for the bearing of the small end of an automobile connecting rod, whilst a steel-backed high-tin-base babbitt bearing is generally used for big ends. In the latter instance the bearing metal is low in mechanical strength, melting point and fatigue resistance, but this is offset by good bonding characteristics, low friction effect, good non-scoring characteristics, etc. The last property is best determined by actual service test, since it may vary from engine to engine, according to design. Fatigue resistance must be rated on the actual engine, but it is possible to make preliminary tests on a laboratory testing machine (described and illustrated). Conformability is the property that permits a bearing to deflect or distort to give a uniform distribution of pressure, and can result from suitable design of the bearing and/or by composition of the bearing alloy. The property that allows the embedding of small dirt particles in the bearing, thus decreasing their abrasive action, is termed embeddability. Corrosion resistance is of considerable importance. The formation of acidic compounds by oxidation of lubricating oils under service conditions is to be avoided to effectively reduce corrosion. The modern methods of refining, however, successfully yield lubricating oils that are very resistant to the development of these corrosive compounds. G. R. N.

227. **X-Ray Diffraction Studies of Lubricants.** G. L. Clark, R. R. Sterrett and B. H. Lincoln. *Ind. Eng. Chem.*, 1936, **28**, 1318.—The molecular structure of thin films of compounds, which on addition to lubricating oils increase the film strength, is determined by passing an X-ray beam tangentially to a thin film of the material on a cylindrical brass rod, and examining the resulting diffraction pattern. The following are the authors' observations and conclusions:—

(i) Long-chain fatty acids and the corresponding chlorinated acids show that the layer is composed of double molecules.

(ii) Chlorinated esters of the long-chain fatty acid–short-chain alcohol type show the composition of the film to be of double molecules.

(iii) Long-chain fatty acid–short-chain alcohol unsubstituted esters show the composition of the film to be of single molecules.

(iv) Substituted short-chain fatty acid–long-chain alcohol esters and long-chain fatty acid–long-chain alcohol esters also show a structure consisting of single molecules.

(v) Substances of the foregoing types which show a layer composed of double molecules are those which produce the greatest increase in film strength.

(vi) Chlorinated ring compounds shown by means of X-rays to possess a definite molecular orientation with the plane of the ring parallel to the metal surface are capable of greatly increasing the film strength of lubricating oils; chlorinated ring compounds not exhibiting molecular orientation at the metal surface are less effective in increasing the film strength of lubricants.

(vii) The molecular structure of the film of a given substance is found to be independent of the metal with which it is in contact. The degree of molecular orientation is, however, dependent on the nature of the metal beneath the film. Esters and ring compounds appear to have better orientation on iron and zinc surfaces; chlorinated and unsubstituted stearic acids exhibit their best orientation on copper; esters scarcely exhibit any orientation on copper. Trichlorophenol and dichloroethyl stearate gave by far the best molecular orientation.

(viii) Molecules of chlorinated "addition" compounds are highly orientated in the liquid state, and because of the strong binding forces they are enabled to group together in the lubricating oil blends and make their binding effect felt on the surrounding hydrocarbon molecules.

(ix) On heating lubricating oils containing chlorinated "addition" compounds in contact with a metal surface, some reaction takes place between the chlorinated molecules or the blend constituents. This seems to produce a stable solid material which is attached to, and orientated on, the metal surface in the form of a thin but resistant film. This reaction is catalysed to a varying extent, depending on the metal. No reaction of any kind is observed for unsubstituted compounds or in their blends with oil. This observation may have considerable bearing on the problem of the efficient performance of chlorinated compounds as "addition" agents to lubricating oils.

The authors have also developed an X-ray method for the measurement of surface wear. In this test the extent of the fibre structure of the brass pins used in the Almen machine is measured by means of an analysis of the X-ray diffraction pattern before and after the test. The changes in the degree of fibrosity is a measure of the wear. The results demonstrate that oils containing compounds capable of increasing the film strength also decrease the abrasive wear between rubbing surfaces. J. W. H.

228. The Acetone Extraction of Constant-Boiling Lubricating Oil Fractions. B. J. Mair and S. T. Schicktanz. *Ind. Eng. Chem.*, 1936, **28**, 1146.—A water-white lubricating oil prepared from a dewaxed SO_3 raffinate from Mid-Continent petroleum, by treatment with silica gel, was separated by distillation into fractions of substantially constant boiling point. Each of these fractions was further separated, with respect to the type of molecule, by solvent extraction with acetone containing 1·5% of water, into 25 to 35 fractions by means of a 14-metre reflux extractor column. Extensive physical data are given on these fractions, which show that by this method excellent separation with respect to molecular type can be obtained from fractions consisting of compounds of the same mol. wt. J. W. H.

228a. Comparison of the Physical Properties of Lubricating Oil Fractions with Synthetic Hydrocarbons. B. J. Mair and C. B. Willingham. *Ind. Eng. Chem.*, 1936, **28**, 1452.—The physical properties of the lubricating oil fractions, prepared by the method described in the preceding abstract, are correlated with each other and with the physical properties of synthetic hydrocarbons. The highest-quality raffinates are shown to consist substantially of naphthenes (*cyclo*paraffins) containing from one to three rings per molecule with the necessary alkyl radicles. Lower-quality raffinates contain naphthenes with more rings, together with some unsaturated hydrocarbons and possibly some aromatic hydrocarbons. There is no evidence for the existence of iso- or branched chain paraffins. Attention is directed to the possibility that in the extraction processes used at present one ring aromatic hydrocarbons of high viscosity index are being discarded to waste together with the undesirable naphthenes containing approximately six rings to the molecule, due to their similar solubility relation.
J. W. H.

229. Increasingly Powerful E.P. Lubricants Required for Automotive Rear Axles. H. R. Wolf. *Nat. Petr. News*, 11.11.36, **28** (46), 37.—Failures in hypoid and highly stressed spiral gears are due to tooth breakage, surface pitting and scoring or scruffing. The last is due to the actual welding of the metal along lines of contact as the result of high unit pressure and rubbing velocity. Pressure may rise to 400,000 lb. per sq. in. and rubbing velocity to 1800 ft. per min. The factor PV = maximum tooth pressure × rubbing velocity, is an accurate guide of the tendency of a gear to score. Mineral oil is unsatisfactory when PV is greater than 15×10^6. The principal properties which should be possessed by a satisfactory extreme-pressure lubricant are: (*a*) load-carrying capacity, (*b*) stability, (*c*) absence of corrosive constituents. No laboratory machine gives entirely satisfactory information under (*a*), but the S.A.E. machine is considered to give results most closely related to those obtained from practical trial. E.P. lubricants are not, as a class, as stable as straight mineral oils.

With the lead-soap, active sulphur type it is often not possible to combine maximum lubricating efficiency with maximum stability, and commercially available materials often represent a compromise between these two factors. The " mild " E.P. lubricants, viz. sulphur-saponifiable, sulphur chloride, chlorine or phosphate types, are generally more stable than the more efficient lead-soap, active sulphur type. Loss of efficiency, as distinct from instability, at high temperature is an important consideration. In this respect lead-soap active sulphur lubricants are somewhat superior to lead-soap active chlorine ones. The wear that must be definitely associated with the lubricant itself can be discussed under three headings. (1) That due to mechanical abrasion; (2) that due to failure of the lubricant film to prevent metal to metal contact, and (3) that due to corrosion. The lead-soap in most E.P. lubricants appears to function as an efficient corrosion inhibitor. H. G.

230. S.A.E. Programme on Extreme Pressure Lubricants. *J.S.A.E.*, 1936, **39** (5), 23–24.—In this progress report of the transmission lubricants sub-division of the S.A.E. Standards Committee (Lubricants Division), the rear axles now running on the road are divided into three classes. E.P. lubricants are required for two classes only. The smaller but rapidly expanding class made up of the comparatively recent hypoid gear requires a lubricant which will carry a load of 550 lb. under conditions stated. For the larger class of spiral bevel gears, such high load-carrying capacity is not necessary, and it is considered that a figure of 250 lb. is satisfactory.

Incidentally, a straight mineral oil which is used for by far the largest class of gears will carry a load of approximately 50 lb.

The figures quoted are obtained on the S.A.E. test machine which is being referred back for modification and detail improvements.

The warning is given that the other characteristics of the oil not subject to classification must not be ignored, *e.g.* oxidation resistance. It is hoped that in 6 months' time a classification of E.P. characteristics will be possible. Meanwhile, agreement has been reached that for hypoid gears there is no necessity to exceed a viscosity represented by S.A.E. 90. J. L. T.

231. Lubricating Oils from Coal. *Chem. Trade J.*, 4.12.36, **99**, 474.—The Fuel Research Board report for 1936 describes the work carried out in conjunction with the Lubrication Research Committee on the production of first-class lubricants from coal. Very little success was reported, synthesis from CO and H_2 being regarded as the most hopeful line of attack. In view of the adverse N.P.L. report on the lubricating qualities of oils obtained by direct polymerization of low-temperature carbonization spirits with $AlCl_3$, no further work has been carried out in this direction.

Condensation with ethylene of an oil obtained from the hydrogenation of coal gave a more stable product than the original oil, but was not as good as the product given by rehydrogenation. Polymerization of ethylene itself was investigated, but this gave oils of very high viscosity temperature coefficients. Varying the catalyst and operating conditions gave a wide variety of oils of very low viscosity. This, however, was improved by treatment with $AlCl_3$ at 60° C., the viscosity temperature coefficients being also good. The utilization of the unsaturated hydrocarbons produced by coal carbonization is being investigated in the connection.

Lubricating oils have also been produced by treating the primary products from the Fischer process with anhydrous $AlCl_3$ and larger-scale investigations are being put in hand. The transformation of water gas into lubricating oils, with alcohol as an intermediate product, is also being investigated. C. L. G.

232. Pure Fatty Acids for Grease Manufacture. M. L. Sheely. *Nat. Petr. News*, 28.10.36, **28** (44), 26.—The author classifies the commercial fatty oils under four headings, according to their chemical composition: (1) Coconut, Palm Kernel, Babsu; (2) Palm Oil, Beef Tallow, Lard; (3) Cotton-seed, Corn, Peanut, Soya Bean; (4) Menhaden, Whale. All these are complex mixtures of fatty acids and their glycerides. It is claimed that such oils vary sufficiently in composition to affect the properties of lubricating greases prepared from them. The commercial preparation of pure fatty acids from neutral oils has not been feasible, except by the somewhat unsatisfactory

method of crystallization, as in the case of stearic and oleic acids, until the recent adaption of high-vacuum fractional distillation technique as applied in the petroleum industry. It is claimed that such a plant is producing commercially pure stearic, palmitic, myristic (80% pure), lauric (85% pure), capric and caprillic acids. The use of such pure fatty acids for grease manufacture is advocated, and the following advantages are claimed for them : (1) control of fat composition ; (2) ease and completeness of saponification ; (3) greater yield of anhydrous soap ; (4) greater uniformity of finished product. H. G.

233. New Oxidation Test for Greases. H. A. McConville. *Nat. Petr. News*, 21.10.36, **28** (43), 36.—Two No. 203 bearings are mounted on the ends of a steel shaft 6 in. long, and the starting torque of the system is measured by loading a pan attached to a flexible cord wound around a 1½-in. diameter pulley situated centrally on the shaft. On test a pair of bearings are thoroughly cleaned and carefully packed with the grease. They are fitted to the shaft and the initial S.T. is measured. The bearings are removed and placed in a thermostatically controlled oven at 175° F. for 2 weeks. A steady stream of moist oxygen is passed into the oven, which also contains a 100-watt electric bulb as a source of light. Light has been found to accelerate oxidation appreciably. The bearings are replaced on the shaft at the conclusion of test and the S.T. is re-determined. Tests are carried out on worked and unworked specimens. The same apparatus is used for studying the increase in resistance to motion occasioned by fall in temperature. For this the whole apparatus, with the exception of the cord and pan, is placed in an insulated box which is cooled by the introduction of liquid nitrogen. The low-temperature characteristics of a grease appear to depend chiefly on those of the oil used. The " freezing point " of grease is raised considerably by oxidation. It is stated that, as the result of a comprehensive survey of greases, the maximum viscosity of the oil used should be 500 seconds at 100° F. and that the range of worked consistencies should be 250–330. On the assumption that a " buttery " consistency is desirable, mixed base greases are preferable. In order to measure " running torque " the B.E.C. machine has been modified. A 1 h.p. variable-speed motor has been coupled to a steel shaft fitted with a No. 312 bearing in a standard housing free to turn on the shaft, but attached to a spring balance. It is planned to modify this machine further by making provisions to cool the housing and to study " channelling " visually by removing the side of the housing after a test run. H. G.

234. Patents on Lubricating Oil. E. I. Du Pont de Nemours & Co., E.P. 458,105, 14.12.36. Lubricating oil is blended with a pour-point depressant, *e.g.* condensation product of chlorinated paraffin and a polycyclic phenol ether.

J. A. Anderson. U.S.P. 2,059,837, 3.11.36. Separation of crystalline wax from a wax-containing oil by adding 0·05–0·5% of triethanolamine, dissolving the oil–wax soap mixture in liquid propane, chilling to precipitate wax and then separating the solid wax from the diluted oil.

F. X. Govers. U.S.P. 2,060,805, and 2,061,541, 17.11.36. Dewaxing of lubricating oil using methylethyl ketone and toluol or benzole.

J. R. Miller. U.S.P. 2,061,666, and A. E. Wilkoff, 2,061,687, 24.11.36. Apparatus described for purifying or renovating crankcase oil of motor vehicles.

L. D. Jones. U.S.P. 2,062,266, 24.11.36. Distillation of wax-containing oil. W. S. E. C.

Asphalt and Bitumen.

235. Asphalt Mining By-products Industry in Sicily. *Petr. Eng.*, Oct. 1936, **8** (1), 108.—Production of rock asphalt in Sicily declined from 171,097 m. tons in 1913 to 49,645 m. tons in 1933, due to changing methods of road construction and competition from petroleum asphalt. During the War, a company was formed to extract the oil from the rock, a yield of 4% being obtainable. Owing to technical and economical

difficulties and to large over-estimation of the quantity of rock asphalt available, only a few thousand tons p.a. were produced. Attempts to extract products from the crude oil obtained were also a failure. C. L. G.

236. Recovery of Bitumen from Mineral Mixtures. O. Pfrengle. *Asphalt und Teer*, 1936, **36** (43), 862–865.—The usual methods for recovery of bitumen are said to be either unreliable, to require elaborate apparatus, or to need supervision over a lengthy period. The author therefore devised a process consisting in repeated extraction of the mineral mixtures with cold chloroform, settling and decanting the bitumen solution, and evaporation of the bulk of the solvent on a water-bath. The residue is transferred to a vessel fitted with stirrer and means for passing a current of carbon dioxide over the surface of the bitumen, the vessel is heated in an oil-bath with thermostatic control, so that the temperature is gradually raised to 120° C. and held at this for two hours, and the carbon dioxide is examined occasionally to determine when all the chloroform has evaporated. It is stated that errors arise from action of solvent on bitumen, during settling and distillation, action of carbon dioxide at high temperatures, and incomplete removal of solvent. The effect on softening point and breaking point of several bituminous materials of varied conditions, *i.e.* time of settling, and time and temperature of heating, during recovery by this process is shown. It is suggested that a correction factor be derived in this manner and applied to results obtained on recovered bitumens. A. O.

237. Measurement of Binding Power of Bituminous Materials. O. Martin. *Asphalt und Teer*, 1936, **36** (45), 899–906.—This article deals with determination of stability of bituminous mixtures. A brief summary is given of the first two sections of the paper and the two last sections are given in full. The method adopted by the author for measuring stability consisted in determining the resistance of the test specimen to penetration of a steel rod, ball, or conical dish under constant velocity. Various binders were examined under varying degrees of H.M. softness and varying velocity, and a number of curves, tables and photographs of test specimens are given. A. O.

238. The Relation between Absolute Viscosity and Penetration of Asphaltic Bitumens. R. N. J. Saal and J. W. A. Labout. *Physics*, 1936, **7** (11), 408.—The results of further experimental investigation show that with purely viscous materials a general relation between viscosity and penetration exists over a wide range. The investigation showed that the depth of penetration depends somewhat on the conditions of measurement. Inadequate adhesion to the needle increases the penetration, but the effect is not great and is the same for all purely viscous bitumens of the same penetration. With elastic bitumens the depth of penetration is increased by interruptions of the determination, as this permits the elastic tension to be dissipated. It is concluded that Traxler, Pittman and Burns (*Physics*, **6**, 58 (1935)), have overlooked the elastic behaviour of some of their bitumens, and that therefore their criticism of the relation between viscosity and penetration previously proposed by the authors is not valid. P. D.

239. Insulating Paper for Road Construction. Anon. *Asphalt und Teer*, 1936, **42**, 847–848.—Papers used for insulating purposes in road construction must possess bursting strengths of more than 0·5 kg./cm.^{2} in the dry state, and 0·2 kg./cm.^{2} after immersion in water, they must also pass a " bleeding " test. The papers are usually bitumen treated, but waxed or sized papers are also used. Papers formerly prepared from soda and starch pulps had tearing lengths of 6000–7000 m., but much lower tearing lengths have been found satisfactory and other materials are now used, and bitumen, in the form of emulsion, is admixed with the pulp. The bursting strength of papers prepared by the latter process can be varied by variation of bitumen content and particle size of the emulsion. A. O.

240. Patents on Asphalt. Standard Oil Co. (California). E.P. 456,600, 12.11.36. Production of asphaltic plastics by oxidizing viscous liquid olefine polymers obtained by the polymerization of gaseous olefins at temperatures above 300° F. W. S. E. C.

Special Products.

241. Production of Drying Oils from Cracked Gasoline. G. M. Woods. *Petr. Eng.* Oct. 1936, **8** (1), 106.—Laboratory tests were made on the oxidation of the unstable components, under pressure and heat, of a vapour phase cracked M.C. naphtha distillate. After oxidation for 6 hours at 100 lb. per sq. in. pressure in a steam-heated bath, the sample was re-run under vacuum to 6% bottoms. The residue had similar properties to linseed oil, comparative data for the two products being :

Gravity A.P.I. 21·4 and 19·8 resp.
Saponification No. 188 and 190.
Iodine No. 180 and 186.
Col. Tag. Rob. 9 and 18 resp.

Practical tests with the synthetic oil in paints gave favourable results, but after 12 months' exposure cracking of the film was in evidence. It is believed, however, that by careful control a satisfactory drying oil could be produced at an estimated cost of 10 c. per brl. on the cracked gasoline, or 4 c. per gal. on the oil. A flow sheet of a suitable plant for the production of this oil is given, reference being made to the enormous market (800,000,000 lb. p.a.) for the higher priced linseed oil (45 c. per gal.).
C. L. G.

242. Natural and Synthetic Rubber. I. Ganitzki. *Mon. Petr. Roum.*, 1936, **37**, 1793–1797.—With the tremendous increase in consumption of raw rubber, the non-producing countries are increasingly aware of the wisdom of producing their own supplies. They have three alternatives: (1) regeneration of used rubber, (2) discovery and cultivation of new rubber-producing plants, (3) synthetic rubber.

The article shows how the problem is being solved, particularly by Russia and Germany. Several brief tables are given, showing figures for imports, exports, stocks and consumption of natural rubber in the main markets. While the future of synthetic rubber from cracked petroleum gases is acknowledged, only a few brief references are made to this aspect. Regeneration of used rubber is being developed mainly in the U.S.A., but Russia and Germany are interested to some extent. The article gives considerable data on the position in Russia, where rubber is being produced in considerable quantity from both new rubber-producing plants, such as Kok-sagaz, and synthetically from ethyl alcohol derived from potatoes. Figures are given showing the production of rubber from new plants, and of the extent of, and yield from, the plantations. For instance, one hectare of Kok-sagaz plantation yields 270 kgm. of raw rubber once every three years, or about one-fourth the yield from a tropical plantation of Hevea trees. With the help of the five-year planning, the author estimates future development. Similar figures are given for the ethyl alcohol from potatoes. It is significant that Russia has planned fourteen new factories, valued at 190,000,000 roubles (38,000,000 dollars), for the production of ethyl alcohol for synthetic rubber. Eleven of these factories will be in operation before 1938. Although improving, the bulk of Russian home-produced rubber is at present inferior to the natural.

The I.G. Farb. in Germany have developed the production of synthetic rubber by the polymerization of butadiene, and have recently succeeded in producing a rubber which is claimed to be more elastic and durable than natural rubber. T. C. G. T.

243. Ceresin from Coke. E. Graefe. *Ole Fette, Wachse*, 1936 (13), 1.—Solid hydrocarbons are produced as by-products in the Fischer-Tropsch benzine synthesis. The wax, which collects in the catalysator, has a high s.pt. (generally $>100°$ C.) and high mol. wt. (to 2000), and its molecules may contain up to 150 C atoms. It is stated to be amorphous in structure and its cooling-curve shows no definite break corresponding to the s.pt. The wax has a high binding power with respect to solvents such as "Sangajol."
P. G. H.

244. Specifications for Insulating Oils. A. Baader. *Oel und Kohle*, 1936, **12**, 1009, 1093.—The requirements and tests agreed by German standardizing bodies (WEV and

DVM) are described and critically discussed. Oxidation tests are dealt with at some length, chiefly with respect to the relative merits of the Tar Number and Baader tests. The latter is held to assess ageing in a wider sense than does the Tar Number. The possibility of improving on the existing German specifications is discussed.
P. G. H.

245. Benzole Production from Illuminating Gas. V. Schön. *Petr. Zeit.*, 11.11.36, **32** (45), 13.—The production of benzole from illuminating gas by means of finely-divided activated charcoal, "Benzorbon," is described and details, together with diagrams, given of the gas-works plant in Budapest. Two absorbers are utilized in the washing of gases containing benzole vapours—the benzorbon absorbs the benzole as well as all the gases and vapours. The benzole is completely freed from naphthalene and the contents of HCN, NH_3, N_2 oxides and sulphur compounds, especially CS_2 and gum-forming compounds, are decreased to a minimum value. The benzole, after distillation, is inhibited if necessary, to prevent gum formation. W. S. E. C.

246. Patents on Special Products. Usines de Melle. E.P. 458,061, 11.12.36. Manufacture of chlorhydrins by the action of olefines on an aqueous solution of chlorine.

J. Y. Johnson. E.P. 458,100, 14.12.36. Manufacture of chlorbutadiene by passing gases containing vinyl acetylene together with hydrogen chloride over activated charcoal in the presence of halogen compounds of base metals of the second and fourth groups of the periodic system.

W. O. Mitscherling. E.P. 456,537, 11.11.36. Production of propyl butyl and amyl alcohols by subjecting aliphatic hydrocarbons in the vapour or liquid phase in the presence of water, to irradiation from an ionized rare gas.

Standard Oil Development Co. E.P. 456,547, 11.11.36. Conversion of ether to alcohol. W. S. E. C.

Detonation and Engines.

247. Photo-Electric Combustion Analysis. R. A. Rose, G. C. Wilson and R. R. Benedict. *J.S.A.E.*, 1936, **39**, 459–468.—This paper describes the apparatus used and the results obtained in the study of the time relationship between fuel injection, radiation from the igniting fuel, and the pressure changes during the operation of a diesel engine. The authors have made use of a special photo-cell with a response between 0·3 and 1·2 microns for the study of radiation. Light from the combustion chamber is taken through a quartz rod to this cell and suitably amplified, whence the current is passed to a neon tube mounted on the flywheel. The length of the tube becoming incandescent varies with the current received. A second tube is arranged to show the needle-valve opening period, and a third device constructed from a Maihak cantilever spring indicator is used to pick up the pressure impulse in such a way that the photo-cell delivers a current proportional to pressure. Details are given of a special amplifier giving a linear response for recording on a magnetic type oscillograph. Results with a three-beam oscillograph are also described. The latest methods used by the authors make use of three photo-cell amplifiers and three cathode-ray tubes and high-speed cameras. The apparatus has been adapted to many combustion studies and many oscillograms are given showing, for example, the effect of varying design of nozzles. C. H. S.

248. Prolonged Explosion in Internal-Combustion Engines. E. Giffen. *Rev. Comb. Liq.*, Aug./Sept., 1936 (137), 228–231.—It is known that at the end of the explosion in the cycle of "Otto" the gases carry away a large quantity of heat capable of being transformed into energy. One way of utilizing this heat is to proleng the explosion, and many efforts have been made to reach this result, but without any practical success.

The article deals with various suggested methods of solving this problem, and various tables and diagrams are given. It is suggested that the most efficient and practical method of obtaining a prolonged explosion is a predetermined early closing of the inlet valve. M. M. L.

249. Development and Application of the Cathode-Ray Engine Indicator. E. M. Dodds. *J.S.A.E.*, 1936, **39**, 487–495.—The author first describes various electrical circuits which have proved satisfactory for the operation of the gas-filled type of cathode-ray tube, and many applications of this type of indicator are dealt with. The problems arising when an attempt is made to indicate a high-duty aero engine are chiefly mechanical, and render the employment of an exceptionally rigid and robust pressure element imperative. It has been found that the hard vacuum tube is more satisfactory for this type of work, and the author describes the type of electrical equipment developed for use with this type of tube.

An outline is given of many lines of research which have been investigated, and a theory of the mechanism of diesel knock is put forward.

Reproductions of diagrams obtained on various engines are given which throw light on the effect on combustion of various blending agents used as knock suppressors. Curves are given which show the relation between the octane scale and engine pressures, and the paper ends with a list of possible applications of the cathode-ray indicator intended to stimulate the interest of research workers. C. H. S.

250. Heat Loss in High-Speed I.C. Engines. W. T. David. *Engineer*, 25.12.36, **162**, 675–676.—From an analysis of the heat losses during the explosion–expansion stroke, it is estimated that the observed thermal efficiency should be lower than the calculated theoretical value by 5% for gaseous fuels and 5½% for liquid fuels. In practice the difference is considerably less, and four possible explanations are suggested: (1) that the theoretical efficiencies are too low; (2) that the measured efficiencies over-estimate the true performance of the engine; (3) that the theory of the high-speed engine requires some modification; and (4) that heat losses during the explosion–expansion stroke are much over-estimated.

Each of the above possibilities is discussed; the first three, while there may be certain small errors, the author does not consider significant. In a discussion of the fourth possibility, it is concluded this accounts for the discrepancy.

The author believes that the quantum specific heats are substantially accurate, and therefore that the ideal efficiencies based on them are of a high order of accuracy. It is believed, too, that the explosion–expansion heat loss is relatively small in high-speed engines, and that the latter approach much more closely to thermodynamic perfection than is generally supposed. J. G. W.

251. A 5-H.P. "National" Diesel Engine Converted into an Apparatus for Determining the Cetene Value of Diesel Fuels. P. M. von Bemmel and D. J. W. Kreulen. *Fuel*, 1936, **15** (12), 336.—A method of measuring the delay period is described in which the fuel-injector valve movements are measured mechanically and the cylinder pressures by a piston and pencil type indicator. The cetene number of a fuel is determined from the delay period by blending and comparison with known fuels. J. G. W.

252. Fundamental Applications of the Cathode-Ray Oscillograph. R. R. Batcher. *Instruments*, 1936, **9** (10), 286.—The use of cathode-ray oscillographs for studies of frequency, short-time intervals and phase effects is described. P. D.

253. Cathode-Ray Oscillograph Applications. R. R. Batcher. *Instruments*, 1936, **9** (11), 312.—A description of the graphical and mathematical analysis of wave forms. P. D.

Coal and Shale.

254. Scottish National Development Council: Economic Series: Nos. 12 and 13, Scottish Industry. First and Second Reports of the Oil from Coal Committee. 1935; 1936. Pp. 63, 27.—The Scottish National Development Council appointed a representative Committee in January 1934 to investigate the practicability in Scotland of obtaining oil from coal, shale and kindred mineral substances. The general terms of reference are given in the Preface to the First Report. The Report is divided into

two parts. The nature of the recommendations in Part I showed the Committee's desire to promote immediate exhaustive inquiries to facilitate the selection of Scottish coals suitable for low-temperature carbonization and for hydrogenation. In Part II fuller consideration is given to technical details of carbonization at high, medium and low temperatures, to the distillation of coal–oil blends and to hydrogenation. Investigation is also being made of the production of oil from other mineral substances and by synthetic processes. The second Report records that the attention of the Committee was to be concentrated on three methods for the production of oil: (1) the distillation of oil shales, cannels and torbanites; (2) the pyrolysis of such gases as ethylene; (3) synthetic manufacture from gases such as hydrogen, carbon monoxide and carbon dioxide.

The view expressed by the Commissioner for the Special Areas (England and Wales) in his Report of November 1936, is concurred with—that particular attention should be paid to processes which produce no fuel to displace ordinary coal—and recommendations are made regarding the best method of carrying out these suggestions and of providing the necessary finance.

The Cannel Inquiry Sub-Committee express the hope that the information given in the Report will be of value to the gas industry, which has recently returned to the possibilities of cannel coal, extensively used for gas-making 50 years ago. The Report comprises an Historical Introduction, a General Statement, Detailed Statement with 4 tables of Cannel properties, their production and their reserves, 4½ pp. on the utilization of Cannels with two diagrams and concludes with Recommendations and four Appendices. B. F. N. M.

255. Diesel Oils from Coals and Cannels. J. L. Strevens. *Gas & Oil Power*, 1936, **31**, 225.—The best method of utilizing diesel oils prepared by the low-temperature distillation of coal, as fuel for high-speed diesel engines, is to blend them with a petroleum diesel oil to the extent of not more than 25%. Such a blend gives a performance equal to that of the petroleum fuel alone with a slight advantage in m.p.g. The coal oil used in the blend must be washed free from acidic and phenolic constituents and inhibited against ageing. The use of the coal oil as a blending constituent is more likely to prove satisfactory than the use of the coal oil with sole addition of a dope to raise the cetene value. Oils prepared by distillation of coal in a wet oily medium at temperatures around 600° C. appear to have higher cetene values than those obtained by dry carbonization at 600–700° C.

Yields of oil per ton of coal will not be greater than 5–6 gal. by normal carbonization methods. Processes by which coal can be made to yield larger quantities of diesel oil are the modified Fischer and simple hydrogenation.

The Fischer process yields gasoline of low anti-knock value and diesel fractions of high cetene value but low specific gravity, so a combination of the Fischer system with a low-temperature process has possibilities in respect of production of suitable motor spirits and diesel oils from coal.

Neutral oils obtained by the low-temperature distillation of cannel coals are also suitable for use as diesel oil components. Blends with gas oil containing 80% of a neutral oil from Leeswood, N. Wales, cannel coal, behaved quite satisfactorily in a diesel engine. R. A. E.

256. Activated Carbon from Coal. Anon. *Chem. Trade J.*, 4.12.36, **99**, 469.—The Fuel Research Board Report for year to March 31st, 1936, describes an investigation of the production of high-grade carbon, suitable for use in gas masks, from coal.

Sixteen coals of the durain type were examined, being carbonized in a continuous vertical retort, and activated by an upward current of steam, passed counter-current to the descending coal.

It was found that the lower the carbonizing temperature, the higher the volume activity of the carbon, a limit, however, being enforced by the difficulty of activating coal carbonized at too low a temperature (below 450° C.). The most suitable size of coal, limited by the resistance offered to the passage of steam during activation, and, on the other hand, by the steam not penetrating the larger pieces of coke sufficiently, was found to be ¼ in. to 1¼ in. From the most satisfactory coals (main durain band of Top Hard Seam Nottingham, 14 Feet or Main Seam of Kelty, Fifeshire, and slate

portion of Warwickshire Thick Seam) activated carbon was produced which, when crushed and graded, was suitable for use in first grade respirators. C. L. G.

257. Conversion of Coal into Liquid Fuels by the Fischer Process. F. Fischer. *Petr. Times*, 14.11.36, **36**, 613.—Superficial details are given of the process whereby a purified mixture of CO and H_2, in the ratio 1 : 2 are produced from coke (by a process details of which are not given), and passed over a catalyst at atmospheric pressure. No details are given concerning the nature of the catalyst or of the reaction chamber, which is of special design to counteract the exothermic nature of the reaction. The optimum contacting temperature is 190° C. Sulphur in the charging stock must be below 0·2 gm. per 100 m.³. The following products are obtained and in the proportions indicated by the bracketed figures. "Gasol" (8), petrol boiling up to 200° C. (62), diesel oil (24), paraffin wax (2), ceresin (4). The total yield is stated to be 110–120 gm. per 100 m.³ gas. It is stated that the anti-knock quality of the petrol is poor, but that the diesel oil is of satisfactory quality. Figures are given which indicate that an aero-engine lubricant is of quality comparable with that of a well-known automobile engine oil. H. G.

Economics and Statistics.

258. The Petroleum Industry. Economics. S. A. Swensrud. *Min. & Met.*, Jan. 1937, **18** (361), 30, 31.—This is a brief review of 1936 which was the best and biggest year in volume in the history of the oil industry and the best in profits since 1929. Domestic gasoline consumption was the highest on record, being 11% above 1935 and 26% above 1929. The demand for light fuel oil, crude oil prices, crude oil reserves, State proration are all reviewed. The concept of conservation has advanced a little, but real unit operation of oil pools made little headway against the opposition of the adherents of the rule of capture to the principle of ownership of oil and reservoir energy.

Refining and transportation in 1936 are surveyed, and the article finishes on the development and extension of the Iowa plan, whereby refining companies have withdrawn from retailing and have leased out all owned service stations to independent dealers. B. F. N. M.

259. Labour Demands Handicap Mexican Companies. Anon. *World Petr.*, Dec. 1936, **7** (12), 629–631.—This article recounts the passage of the Mexican Expropriation Law. The Minister of Economy has publicly referred to the Government's policy of rationally nationalizing the oil industry by assisting the development of Government-controlled Petromex, in such ways as passing over to it oil lands that the Government had forced privately controlled companies to relinquish, and in other ways to give Petromex an unfair advantage over private companies in Mexico. Prior to the passage of the Expropriation Law, every possible assistance was given to Petromex and every possible legal (and sometimes outside legal limits) hindrance to operation was imposed on the private companies. These measures only resulted in causing greater reluctance on the part of the privately controlled oil companies to abandon their properties developed in many years, than the Government expected. Protests by industrial and commercial groups and by the leading newspapers did not prevent the passing of the Expropriation Law. Following on this the Petroleum Workers Syndicate presented a uniform labour contract to the companies. The grotesque conditions of this contract, which would make it impossible to carry on oil operations in the country were submitted by the companies to President Cardenas, and the threatened general strike on November 29th was suspended for an attempt to be made to reach some sort of settlement. Meanwhile, Petromex is flourishing, and the oil companies face a loss of their entire huge investments. The Mexican people will eventually have to pay in higher prices or taxes. B. F. N. M.

260. Liberal Amendments to Colombia's Oil Law. E. Ospina-Racines. *World Petr.*, Dec. 1936, **7** (12), 618, 619.—Dr. Alfonzo Lopez, President of Colombia, signed on November 14th, Law 160 of 1936, modifying in some important ways the conditions of the Colombian Oil Code, Law 37 of 1931. The principal alterations are summarized

as follows: (1) Definition of the rights of private property on petroleum. (2) Process which the Ministry must follow in reviewing acceptable proofs relative to private property on petroleum. (3) Proofs which accredit such private property. (4) Period within which proceedings may be instituted as provided by general law. (5) Registration of the instruments duly accepted. (6) With a view to establishing refineries in Colombia, crude oils obtained from exploitations of concessions granted under the present law and Law 37 are exempt from royalty, if refined in the country, for domestic consumption.

Other amendments are that, except for the final provision in Article 5 of Law 37, the Government shall require only geological and geophysical data relative to a field from the time the concessionaire has actually started drilling on the property, and that the period during which explorations for oil are allowed is extended.

B. F. N. M.

261. Petroleum in Bulgaria. Anon. *Mon. Pet. Roum.*, 1936, **37**, 1731–1732.—In spite of consistent failure, the search for oil in Bulgaria still goes on. A drilling concession in the Bobovdol region was granted to a Dutch firm in 1935, but no work has been done. Owing to Government interference, the importation of petroleum is a risky procedure. In 1932 the main importing companies combined their Bulgarian interests and formed a new company—" Petrole "—which is now the most important. The first local refinery was erected in 1934 at Roustchouc, and prospered, since the import duty was 1.95 levas per kgm. on kerosine and 5.25 levas per kgm. on motor spirit. Two other refineries followed, and Government customs receipts fell alarmingly. A duty on crude was fixed at 2.10 gold levas per 100 kgm. (About 400 levas = £1 sterling—presumably 1 gold leva equals 100 levas.) On September 1st, 1936, the duty on imported petroleum products was reduced and the price of kerosine fixed at 4.40 levas per kgm. and that of petrol at 10.20 levas per kgm. This was below cost in both cases. As a result, only very small quantities of oil are being sold by commercial firms at these prices, and since September 1st imports have ceased. The distribution is being taken over by the Agricultural and Co-operative Bank with Government subvention to cover the loss. The bank will buy 10,000 tonnes of kerosine, 8000 tonnes of gas oil and 4000 tonnes of spirit, and distribute them. The refineries will probably have to close down, at least temporarily. W. E. J. B.

262. Technology during 1936. A. F. Enström. *Tekn. Tidskr.*, 19.12.36, **66** (Allm. Avd. No. 51), 587, and 26.12.36, **66** (Allm. Avd. No. 52), 597.—The following subjects regarding petroleum industry in Sweden are commented upon by Enström, director of the Swedish Royal Board of Trade, in his annual report on the progress of technology.

Efforts to produce liquid fuels from wood have continued, and constructional details of a high-pressure hydrogenation plant have been worked out. The necessary high-pressure apparatus has been simplified, and a plant can be erected using Swedish materials exclusively. Not only gasoline and lubricating oils, but also higher alcohols and related substances can be produced by this method. Furnaces burning wood instead of coal or oil have been successfully developed. Work to establish specifications and nomenclature for various petroleum products has been initiated. High-speed diesel engines are coming into increased use. The Atlas Diesel Company have developed marine engines with relatively high speeds geared down to the slower propeller speed. Coal tar from gas works has found wide application in preparation of low-price road covering materials. The Ubbelohde Polar Height is favoured as a viscosity–temperature criterion for use in official specifications owing to its more scientific character. Finally the increasing use of oil-heated industrial and domestic furnaces is mentioned. R. F. S.

263. Replacement of Fuel Oil by Peat in U.S.S.R. I. Ganitzki. *Mon. Petr. Roum.*, 1936, **37**, 1441–1443.—The first table in this article shows that in 1932 about 20% of the power generated at the central generating stations of the U.S.S.R. was obtained from fuel oil. In 1937 only 4% will be generated from fuel oil. Actually about 17% will be obtained from coal, 21% from peat, 39% from refuse, whilst about 19% will be produced by hydro-electric power. The total capacity of these central stations

will be increased in 1937 to approximately ten times their capacity in 1913. The latter was about 1,100,000 kw. The stations in each region are designed to run on the fuel best suited to that region. For example, the station at Kachira will burn solely bog-head coal from the "Sous-Moscou" basin. The reserves of peat in the U.S.S.R. represent about 70% of the total world reserve. It is stated that in 200 years' time about 336 thousand million tonnes of peat will be the total reserve. The production of dried peat has steadily increased over the period 1933–1936, and will be further developed in the Ural and Tcheliabinsk regions. This increase of production has been assisted by the mechanization of the industry. Central generating stations constructed during the period 1933–1937 to burn peat only have a total capacity of 747,000 kw. The value of peat as a raw material for the chemical industry has increased during recent times, and gasification plants existing and projected will give about 160,000 tonnes of tar oils per year. W. E. J. B.

264. Exhaustion of Petroleum and a Discussion of Substitute Fuels. A. de Boulard. *J.I.P.T.*, 1936, **22**, 827–830.—A short address with discussion on the problem of the exhaustion of petroleum indicating that there are fair prospects of finding large reserves to combat this exhaustion. With regard to substitute fuels, there are now being applied a limited number of solutions to this problem, but they all suffer from the disadvantage of relative high production cost. G. R. N.

265. Education and Training for the Oil Industry. A. W. Nash. *J.I.P.T.*, 1936, **22**, 790–797.—An authoritative account of the essential features required in the education and specialized vocational training of students intending to enter the petroleum industry. G. R. N.

BOOK REVIEW AND BOOKS RECEIVED.

Review.

COAL, ITS CONSTITUTION AND USES. W. A. Bone, D.Sc., F.R.S., and G. W. Himus, Ph.D., M.I.Chem.E., 8vo. xvi + 631 pp., 134 figs. London: Longmans, Green and Company, 1936. 25*s.* net.

The first edition of Professor Bone's book on coal appeared shortly before the end of the War in 1918, under the title of *Coal and its Scientific Uses*. Although written during a period of exceptional stress, the book contained, in 491 pages of medium size, such a clear, critical and accurate review of the statistical, chemical and technical aspects of the subject at that time, that it quickly became a world-wide "classic" on the subject for students, fuel technologists and many others.

The time was ripe for the appearance of Professor Bone's first book, which gave due prominence to the underlying scientific principles, and it was a marked success. As with all technical and scientific subjects, rapid advances have been made during the past twenty years; new technique on coal treatment has also been evolved. The replacement of the first monograph on coal by a new and revised edition was, therefore, much needed, and would have been welcomed if its sole object had been to bring the previous invaluable store of information up to date. The new volume not only does this by following the same general lines as the old one, but, in addition to the revised portions of Professor Bone's previous publication, embodies much new matter. In this connection may be mentioned an impartial account of the many post-War problems of coal in the light of recent developments, and research, including a brief description of the systematic researches on the chemical constitution and maturing of coals, which have been so long and so carefully carried out under Professor Bone's direction in the Department of Chemical Technology at the Imperial College of Science. These researches have gained a world-wide reputation. The result is that the new edition is a much larger volume, both as regards the number and size of the pages. The authors and publishers are to be congratulated on its attractive appearance. Numerous illustrations, plates, line drawings, flow diagrams and tables give added value to the text. A bibliography is appended to each chapter, and at the end there is both a name and subject index. The paper, printing and binding are well up to the high standard of excellence for which the publishers have been so long noted in their technical publications. Typographical errors are remarkably few.

The strong and commanding personality of Professor Bone, his sound practical knowledge of all that pertains to coal and fuel economy and his intense dislike of mystifying terminology have left their marks in the book under review. What the authors have written will stimulate discussion and further research.

In writing this new edition Professor Bone has been ably assisted by his colleague, Dr. G. W. Himus, Lecturer in Fuel Technology at the Imperial College of Science and Technology, London, as co-author. The volume is appropriately dedicated to Professor H. E. Armstrong, F.R.S., as doyen of British chemists, "in appreciation of his lifelong efforts to advance our knowledge of coal."

A comprehensive treatise on so complex and controversial a subject as coal cannot be adequately or critically reviewed in a few words. All that can be attempted is to give a general idea of the ground covered, to refer to any sections of special interest to petroleum technologists and to add a few personal comments.

The opening chapter deals with the economic aspects of coal from the standpoint of Great Britain and the Empire. In Chapter II Britain's coal problems, including the probable duration of the coal reserves and of the world's oil reserves, come under review. As the authors have no axe to grind, they have discussed impartially the displacement of coal by oil in relation to naval fuel, the mercantile marine and for the heating of large buildings. The following quotations from the text will suffice to show that they have dealt with this matter, as indeed with the whole of the subject-matter of the book, in a true perspective:

"It is mainly the diesel engine, on sea and land, and oil-fired ships' boilers that have

displaced British coal by oil." After stating concisely and correctly the advantages of oil as a marine fuel, they say, "In view of the world's already assured abundance of petroleum for the next generation or two, there seems little prospect of raw coal recovering what it has lost in such directions."

The net imports of petroleum oils are compared for the years 1913 and 1933 in Table XII. The imports for the latter year "totalled about 8,500,000 tons, equivalent in heating power to about 12,000,000 tons of coal." "It should not be supposed that this has meant the displacement of so much coal by oil, for obviously, in so far as aeronautical and road transport are concerned, up to now it has not been so. Moreover, seeing that much coal is consumed in making and repairing a road motor-vehicle, the coal industry should be regarded as having been helped rather than injured by the motor industry."

The authors state that the internal-combustion engine has revolutionized road transport and made possible the aeroplane, adding, "In these two directions it (oil) has scarcely displaced but rather supplemented coal."

They calculate that the potential heat energy of the present total annual output may be considered as equivalent to that of some 360,000,000 tons of coal, and make the following observations on natural petroleum. "At one time many people thought that the world's reserves of oil would soon be unequal to the growing demands for it; but in recent years more scientific methods of locating new oilfields and improvements in pumping, distillation and cracking operations have combined to dispel any fears of an oil shortage, with consequent material rise in prices, for many years to come."

In their treatment of oil from coal, the authors also show commendable common sense. In considering the question as to whether or not oil can in any way be produced from coal in quantities sufficiently large to make it worth while as a national effort, they say, "It behoves us to take account of its economic as well as of the technical aspects." "When Nature supplies abundance of petroleum for the mere drilling of a hole into the earth, it is not much that man can really afford to spend upon converting her coal into oil, however clever he may become at it."

The Carbonization Industries take up 70 pages. All that is attempted within this limited space is a survey of the trend of modern developments, and no attempt is made to enter into details concerning either the design or operation of carbonizing plants; examples are given of the carbonizing of coal at low temperatures, a system which the authors evidently recognize has come to stay. They do not regard it as capable of materially solving our oil from coal problem, but say that it "will play a useful but subordinate part in our national fuel policy."

A chapter is devoted to the hydrogenation of coal, which incorporates the information and illustrations contained in Mr. K. Gordon's paper to the Institute of Fuel in 1935 on the development of coal hydrogenation by Imperial Chemical Industries Limited. The authors express their views on hydrogenation in Chapter II, where they state, "If circumstances compelled the production of oil from coal, at present there seems only one way for it to be done with satisfactory yields, namely by hydrogenation of coal, a process which can also be extended to tar derived from it."

Another way of producing oil from coal or coke is the much discussed Fischer-Tropsch synthesis. Although the quality of the crude product before refining is known to be much inferior to that obtained by direct hydrogenation, this is not stated to have influenced the authors' choice. The absence of any reference to the Fischer-Tropsch process is also noted later on in this review, in connection with the chapter on water gas production. Referring to the impossibility of "home-brewed" petrol being able to compete with imported petrol without the Government's guaranteed preference, they add, "Thus petrol from coal is to be subsidized, not directly from the Treasury, but at the expense of motorists and other petrol users." They state that probably the cheapest and best way of ensuring war-time supplies would be by underground storage. "A coal-oil hydrogenation plant would be an inviting target to hostile aircraft."

The problem of using low-ash pulverized coal in Diesel engines is not overlooked. This is of special interest in view of the fact that when Diesel originally set out to develop the engine now named after him, it was with the idea of its fuel being pulverized coal. The authors claim that the special advantages of an oil fuel could be realized in a relatively de-ashed pulverized coal, and proceed to describe various ways and means of de-ashing run-of-mine coal. They state that the "preparation of coal containing less than, say, 1 per cent. of mineral matter seems now within range of possible achieve-

ment." The authors make no mention of the fact that there already exist in the British coalfields numerous seams or parts of seams of raw coal, which have been proved on analysis to contain less than 1 per cent. of mineral matter without any previous treatment. The important question of conservation or storage of this low-ash coal for future use in powered fuel engines is not discussed. At present large quantities are being consumed as domestic coal. Particulars of these seams have been published in the reports of the National Coal Survey by the Fuel Research Board.

Pawlikowski's work on the coal dust engine is briefly described, and a plea is made for more research on the explosion of coal-dust and air, with a view to improving the engine design. That the authors regard pulverized coal as a fit substitute for oil is evident from their statement that " under resolute leadership the problem should be solved within a decade to the ultimate great advantage of our coal industry."

In addition to the subjects already referred to, the book reviews the geological and chemical aspects of the coal series. It deals with the fundamental properties, classification and geographical distribution of coals. The chemical constitution of coal, so far as is known, takes up about fifty pages. The progress which has been made in recent years has been admirably summarized, but the sum total of our present state of knowledge is pathetically small. The complexity of this problem, in the opinion of the reviewer, calls for a team of first-class organic chemists, prepared to work for many years, in order to tackle it effectively. The solution of this problem is one of paramount importance to the coal industry if the utilization of coal is to be directed properly.

The combustion of coal and the action of oxygen on coal receive the attention one would expect from such authorities on combustion. The latest research on combustion seems to identify the unstable complex C_2O_3, which Rhead and Wheeler regard as the primary product in the action of oxygen upon carbon, with graphitic oxide, that remarkable compound (easily prepared from Ceylon graphite and oxygen), which decomposes violently on heating in a test tube, with a voluminous production of light fluffy carbon black.

The chapter on the preparation of coal for the market might with advantage have included :

(1) The breaking of coal and coal-breaking plant,

as this has become, in recent years, standardized practice at most collieries in view of the rapid falling-off in the demand for large coal, and

(2) The oil spraying of coal, primarily as a means of dust prevention.

This spraying of coal with a small amount of oil has other advantages than that of de-dusting. It is becoming common practice in the coalfields of U.S.A., and is now creating considerable interest in this country also.

Attention is given to the subject of domestic heating, ventilation and the heating requirements of a modern British house. A comparison is made of the prime cost in therms of coal, coke, gas and electricity. Seeing that oil is frequently used in large central heating installations, it might with advantage have been included also. The merits of the open coal fire are given, and the factors determining the comfort and health in living-rooms, which include the physiological effect of the radiation from a coal fire in an open grate.

Methods of measuring some of these factors are described, including Sir Leonard Hill's well-known Kata thermometer.

Two chapters are devoted to the smoke nuisance and smokeless fuels. Quite rightly the smoke nuisance is not confined to its most conspicuous but least harmful constituent, unburnt carbon. The grit, dust, ash, sulphur and acid fumes emitted during the combustion of coal for both domestic and industrial purposes are discussed, together with the best practicable means for their removal. Although still somewhat costly, adequate means are available for the prevention of excessive emission of dust and grit into the atmosphere, and its pollution by carbon and acid fumes can be prevented. Recently a means has been found for burning bituminous coal almost smokelessly in an open fireplace by igniting it from above with a " Bunsen " type of coal-gas flame to bring about complete combustion of the smoke, most of which is formed in the initial stages of the burning of coal.

Two chapters are devoted to the complete gasification of coal and the production of water gas. In neither has any mention been made of the application of these processes in Germany to the production of oils from coal by the Fischer-Tropsch process.

Probably the reason lies in the fact that at the time the authors prepared their manuscript the Fischer-Tropsch process was still in an experimental stage. It is only recently that a number of large-scale commercial plants have been installed, and the economics of the process are not yet known.

An interesting account is given of incandescent surface combustion, with which one of the authors has been so closely associated, being the co-inventor with McCourt of the Bonecourt Surface Combustion Furnaces. The reviewer was interested to note the frank admission of the limitations of this form of heating in the early form of radiophragms, which he found to be quite unsuitable for use in a furnace required to work at about 1200° C., owing to an invariable striking back of the combustible gas mixture in the feeding chamber behind it.

It is interesting to note that F. J. Cox is said to have found a means of completely overcoming this difficulty. A description of this most important improvement would have been welcomed.

Other chapters deal with the utilization of coal, the uses of pulverized coal, boiler design and management, power production, fuel economy in the manufacture of iron and steel, and heat transmission in industrial furnaces. All of these subjects are systematically discussed in the light of history and modern practice.

The reviewer has not found any important errors. He has no hesitation in saying that the book will be recognized as a standard work until such time as a revision is again called for. He can recommend it with confidence not only to fuel technologists, but also to that wider circle of readers who desire to have an accurate knowledge of coal and all its actual and potential uses. Politicians should read, mark, learn and inwardly digest its contents, seeing that the prosperity of this country has been built up on coal, and that coal still touches the life of our nation at every turn.

W. H. C.

Books Received.

Granulometric Studies in Northern Argentine. Tor H. Hagerman. Pp. 89, pl. 7.

This publication contains reprints from *Geografiska Annaler*, Vol. XVIII, 1936, granulometric studies of sedimentary series in Northern Argentine, and includes a short review of the regional geology of Central South America.

Institution of Mechanical Engineers, Proceedings. Vol. 132, January to March 1936. Pp. xi, 612. London, The Institution, 1936.

Included in this volume of proceedings are the papers read at two symposia, the first on Fuel Injection Equipment (pp. 397–429), and the second on Methods of Testing Internal Combustion Engines and Comparative Fuel Economy of Engines in Test and in Service (pp. 431–466).

U.S. Geological Survey:

Bull. 847-B. The Rosebud Coalfield, Rosebud and Custer Counties, Montana. W. G. Pierce. Pp. 78. 1936, Superintendent of Documents, Washington, D.C. $1.25.

Bull. 864-C. Mineral Deposits of the Ruby-Kuskokwim Region, Alaska. J. B. Mertie, jr. Pp. 131. 1936, Superintendent of Documents, Washington, D.C. 25 cents.

Bull. 870. Geology and Ore Deposits of the Bayard Area, Central Mining District, New Mexico. S. G. Lasky. Pp. vi + 144. Superintendent of Documents, Washington, D.C. 80 cents.

This Bulletin, prepared in co-operation with the State Bureau of Mines and Mineral Resources, New Mexico School of Mines, deals specially with the geology of 8·75 square miles—the Bayard area—and the various ore deposits. There is one short paragraph on vanadium minerals.

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Geology.

266. D'Arcy Exploration Company's British Oil Search. Anon. *Petr. Times*, 13.2.37, **37** (944), 217–221.—Test wells drilled in S. England have Jurassic and Lower Cretaceous horizons as their objective, such beds showing indications of oil in Kent, Sussex and Dorset. The Jurassic provides possible source-rocks over a wide area. The test wells at Portsdown and Henfield have found only slight traces of oil in the Lower Cretaceous, Upper and Middle Jurassic, whilst the Lower Jurassic is yet to be tested. There is no thinning of the Jurassic on the S. flank of the Weald anticlinorium, as suggested by some. The succession drilled through at Portsdown and Henfield is described. The main reason for failure is thought to be the lack of sufficiently porous and permeable reservoir rocks.

In the Notts, Lincs and E. Yorks area, traces of oil at exposures give hopes of production from the Carboniferous. Possible oil-bearing structures are being searched for by geophysical methods. In N.E. Yorks, the Magnesian limestone (Permian) is to be tested, which gives indications of oil in Durham, and bears analogy to the producing formation of the Volkenroda field of Thuringia. In Scotland, the Cousland dome, east of the Pentland Hills, is to be tested to the base of the Lower Carboniferous, where production may be obtained from sandstones and limestones interbedded with the oil shale group. A. J. H.

267. Recent Oil Developments in Alberta. E. H. Cunningham Craig. *Petr. Times*, 30.1.37, **37** (942), 144, 158.—The search for oil in Alberta has been widespread, but much of the drilling has been unsuccessful. In the Turner Valley structure, oil that had migrated eastward across a strike fault, upthrowing westward, was found in the Blairmore group on the W. side of the valley. The best production was obtained on the W. flank of the S. pitching end of the structure. The source-beds of the oil lie in a long narrow belt west of Turner Valley. Being considerably cut up by thrusting, the belt contains few areas where production is likely. However, except for the overthrust area of Waterton Lakes, and the Athabasca tar sand area, adequate supplies of oil may be expected only in this belt. The Elbow River anticline, although not ideal, is one of the most favourable structures. A. J. H.

268. Basin Possibilities Indicated by Recent Kansas Completions. L. G. E. Bignell. *Oil & Gas J.*, 14.1.37, **35** (35), 23, 28.—A well recently drilled in Clarke Co., Kansas, discovered oil in the Viola Lime at a depth of 6481 ft. Several wildcat wells previously drilled in this area found gas production at various horizons, and tend to confirm the theory that a basin exists south of the Barton Arch. Along the Sierra Grande Las Animas Arch in N.E. New Mexico and S.E. Colorado the Pennsylvanian or Permian rests directly on pre-Cambrian, and this condition of unconformity may result in stratigraphic traps.

The Ellsworth Arch may play an important part in any oil and gas accumulations within the basin. It has a general N.E.–S.W. trend, but the structural trends in this area are not definitely known, and they may be either N.E.–S.W. or N.W.–S.E.
J. A. G.

Geophysics.

269. Geophysical Advancements Keep Pace with Stringent Gulf Coast Requirements. B. Mills. *Oil Weekly*, 18.1.37, **84** (6), 35–42.—Geophysics is the leading exploratory method of all large companies along the 400-mile strip of the Texas–Louisiana Gulf Coast. Starting in 1923 as progressive from where other methods stopped, the science has advanced from imperfect and incorrect work, due to inexperience in interpretation of data, to the inception of a long series of discoveries not yet finished. By reworking more intensely old areas, many fields have been discovered. 1937 will see a number of submarginal prospects worked for new clues.

Most of the geophysical work is now done with the torsion balance and reflection seismograph. Preliminary work for quick information of possible prospects is done by the torsion balance, and is usually followed by a more detailed examination with reflection seismograph. When time is not a major factor, the reflection seismograph

undertakes both the preliminary and the subsequent detailed survey. Shooting along straight lines between distant points is sometimes a practice in reflection seismograph programmes, but the torsion balance more generally employs the straight-line survey. One or all of three methods have been worked over a great part of the 400-mile strip, but the geophysical work now in hand requires closer accuracy than any work in the past. This additional work involves not only a more extended range of the areas previously regarded as favourable, but also many sections formerly classed as unpromising, in the hopes of finding deeper indications of oil. Geophysical programmes now embrace (1) old prospects, (2) reconnaissance, (3) second- and third-rate prospects, (4) faults, (5) twin domes, (6) domes in immediate vicinity of old prospects.

Tepetate in Louisiana and Hastings in Texas are cited as instances of postponed discovery due to erroneous interpretation of torsion balance and seismograph pictures. Faults or an apparent lack of closure have previously caused some prospects to be classed as third-rate, but the big companies now demand careful study to be made of any unusual change in formation even if the variation cannot be accurately defined. The discovery of some oilfields in areas rejected by major companies has led to a more liberal attitude towards possibilities which were previously considered too speculative. Seismograph work has developed from wide reconnaissance determination to such detail work as being able to pronounce on whether a well already finished should have been drilled or has been drilled on the predicted structural high, or down the flank of a fold.

Reconnaissance work now in progress costs on an average $4000/month for torsion balance crews and about $9000/month for seismograph outfits, but with wide variations according to conditions. The procedure with torsion balance in reconnaissance work with subsequent checking by seismograph is described. The complex aspect of many faults creates frequent difficulties in geophysical work, since a clear picture is extremely hard to obtain. Many of the big companies are now looking for a closure against faults with a possibility of accumulations on the downthrow side, since Tepetate and Cotton Lake, Texas, fields seemed to manifest such anomalous conditions. The possibility of the existence of twin domes is attracting attention in a few districts. Disagreement in the interpretation of geophysical data on the closure question has given rise to an alteration of views on the amount of closure required for first-rate prospects. The alliances of the geologist with the geophysicist in all his activities is essential to perfect interpretation.

In reflection seismographic work, reflections from formations over 10,000 ft. deep are often made, and it is not difficult to reflect from beds 15,000 ft. deep along the Gulf Coast. The intensity of the waves varies with the size of the shot. Various improvements in geophysical equipment include the "swamp buggy" (three plates), a grotesque automobile with four gigantic pneumatic tyres, which easily float the heavy vehicle in 6 ft. of water and act as paddles from the four-wheel drive. This monster is amphibian and goes equally as well on water as on land. It can climb out of water on to a bank and vice versa. Improvement in receiving equipment has largely decreased the quantity of dynamite used to obtain satisfactory reflections. As little as $\frac{1}{10}$ oz. has been used, and the amount used for each shot varies from a few ounces to 100 lb., with very small shots the general rule. B. F. N. M.

270. Temperature Measurements in Oil Wells. M. Schlumberger, H. G. Doll and A. A. Perebinossoff. *J.I.P.T.*, 1937, **23**, 1–25.—A paper with discussion dealing with temperature measurements in oil wells and their significance in field problems, together with a presentation of thermometric technique illustrated by practical examples. G. R. N.

271. Reversed Refraction Arcs in Seismic Surveying. R. Davies. *J.I.P.T.*, 1937, **23**, 31–39.—A paper with discussion on the application of the A.I.O.C. Refraction Arc method of seismic surveying to the exploration of an area which presented difficulties with the ordinary method. G. R. N.

272. A Method of Testing Reflection Seismographs. J. H. Jones. *J.I.P.T.*, 1937, **23**, 26–31.—A method is described in which the actual reflection experiment is simulated under controlled conditions. G. R. N.

273. Exploration by the Reflection Seismograph. E. E. Rosaire. *J.I.P.T.*, 1937, **23**, 40–56.—A paper with discussion on the use and development of the reflection seismograph in the Gulf Coast areas of Texas and Louisiana. G. R. N.

274. Electrical Exploration of Drill Holes. A. Deussen and E. G. Leonardon. *Drilling and Production Practice*, 1935, A.P.I. 47.—Describes the principles applied in electrical surveys of drill holes and outlines the chief applications thereof. Electrical surveys give better and more complete information at much less cost than extensive mechanical coring. W. W.

Drilling.

275. Drilling-in Rotary Wells under Pressure. H. Otis. *Petr. World* (LA), 1936, **33** (6) 36.—Briefly describes the method, the conditions under which it has been employed and what little equipment—in addition to the customary rotary tools—is necessary. The term "drilling under pressure," as employed in this article, means drilling-in with the well flowing under control throughout the drilling-in operation. Permitting, or in some instances causing, the well to flow is accomplished by employing a circulating column—usually a mixture of oil and gas—which exerts less pressure at the bottom of the hole against the formation than does the formation itself against the circulating column.

Two advantages of the method are assurance of a clean sand face and a gauge of the productive capacity of each foot of hole as it is drilled.

The bottom-hole pressures encountered in the 6500-ft. wells drilled-in by this method in the Oklahoma City Field range from 600-lb./sq. in. downwards, whilst the pressure of a column of light mud is well in excess of 3000 lb./sq. in. The equipment used almost exclusively at this field, where the fire hazard is an extremely serious matter, is a self-aligning rotating stuffing-box for a square kelly joint, in combination with a heavy-duty pressure-operated oil saver. Moving costs are negligible, since the equipment weighs only 1800 lb., and rigging-up time is a matter of a few hours only.

Surface working pressures are seldom more than 200 lb./sq. in., more often less than 100 lb./sq. in., even though the well when completed may have a relatively high closed surface pressure. These low surface working pressures are secured either by flowing the well nearly open, or by maintaining it nearly fully loaded with oil while making a trip with the drill stem. W. W.

276. Casing Line Data and Application. R. B. Southworth. *Petr. World* (LA), 1936, **33** (7), 33.—Paper read before the Los Angeles Spring Meeting, Pacific Coast District, A.P.I. The information contained therein was gathered to determine what actually happens in the casing lines of a rotary rig during drilling operations. For the investigation of live-line and dead-line loads an eighth scale model rig was set up, using a 20-ft. steel derrick and ⅛-in. wire line. Tests were made with 6, 8 and 10 lines up, with bronze bearings, and again with roller bearings in the crown and travelling blocks. Loads from 100 to 1750 lb. were hoisted, and the results obtained by 0–200 lb. range weight indicators were tabulated and graphed. A field test using 1-in. line with 8 lines up substantiated the findings of the model test. The model test brought out the fact that the load carried by the hook is not equally distributed between the 6, 8 or 10 lines up, that the fast line carries the greater part of the load coming out of the hole, and that the dead line carries the greater part of the load going into the hole. With the brakes set, the weight indicators stood at the figures shown in the tables. W. W.

277. Newhall Oilfield. R. W. Walling. *Sum. of Operations, Calif. Oilfields*, 1934, 4th Quarter, **20** (2), 5–58.—A report on the Newhall oilfield, which lies in the north-western part of Los Angeles County, California, covering history of development, oil and water horizons, sub-surface conditions, drilling technology and production for the various areas concerned. W. W.

278. Oilfield Operations in 1934. R. D. Bush. *Sum. of Operations, Calif. Oilfields*, 1935, 1st Quarter, **20** (3), 5–58.—A résumé of California oilfield operations in 1934 covering production, drilling and development. W. W.

279. Water Control with Air-Pressure Revives Wells. F. R. Cozzens. *Oil Weekly*, 11.1.37, **84** (5), 18.—Water has had a most damaging effect on oil-bearing sands, and unfortunately control measures are complicated because certain oil sands hold water and in some instances there is a continual seepage of water into sands due to improper plugging of abandoned wells. Drainage of the sand is the only recourse, and controlled air pressure has been found to be the most successful method.

In the redrilling of abandoned territory where surface water has crept in, water contro by air pressure is proving especially valuable. L. V. W. C.

280. Deep Field Development Practice. J. A. Kornfeld. *Petr. Eng.*, Jan. 1937, **8** (4), 58.—Modern trends in the development of the deep fields in the Gulf Coastal region are indicated by the methods adopted.

Geophysical surveys have shown that the Kent dome overlies a deep-seated offshoot of the salt-dome plug found in the Dickinson field. The salt is believed to lie at about 11,000 ft. and production is found in the middle Oligocene comprising the Frio sand series which have a thickness in excess of 950 ft. in this locality. The discovery well was completed at 8554 ft. and the producing sand was found to be 20 ft. thick. The initial tubing pressure was 1700 lb. with a casing pressure of 2800 lb. These pressures increased after the well was cleaned. The oil-string was 7 in. and was cemented with 400 sacks of cement. A string of 2½-in. tubing was run. In future operations the casing programme will be two strings and a conductor instead of three strings. The conductor pipe is electrically welded. A maximum deviation of 4 degrees is allowed. The oil-string is set through the sand and the pipe gun perforated.

L. V. W. C.

281. Well-Planned Programme Marks Development of Tepetate Field. K. C. Sclater. *Petr. Eng.*, Jan. 1937, **8** (4), 34.—A well-planned programme of development was put into operation in the Tepetate field, and this has been facilitated by the fact that the Continental Oil Company owns all the productive acreage. At least 45 wells have been drilled since August 1935. The average completion time per well is about 30 days. Derrick foundations, which are of concrete, and derricks and steel substructures are carried out under contract. The formations are soft and easy to drill for the most part and drag-type three-way bits are used almost entirely. Rock bits are employed occasionally. The commencing hole is 16 in. and is carried to 1500 ft., where 10¾-in. casing is set and cemented. A 9⅞-in. hole is then carried to bottom, and 5¾-in. casing set and cemented. Drilling mud of 9½ to 10 lb. per gallon is used to drill to the top of the sand and before drilling-in the mud is entirely reconditioned and the weight brought up to 10·8 to 11·4 lb. with a viscosity of 36 to 38. L. V. W. C.

282. Unitized Drilling Rig used in Wildcat Operation. N. Williams. *Oil & Gas J.*, 10.12.36, **35** (30), 30.—A new rig which is being used on a deep test being drilled in the Fort Bend County, Texas Gulf Coast, is unitized to distribute the aggregate load into three distinct units, the draw-works and rotary unit, the mud pump unit and the sectional demountable derrick. The drilling unit and the mud pump unit are mounted permanently on semi-trailers. The derrick can be transported easily on a pole-type oilfield trailer. The rig is designed to drill to depths of as much as 6500 ft. using 3-in. drill pipe. L. V. W. C.

283. Amerada Sets Long String of Casing in Wyoming. R. Ingram. *Oil & Gas J.*, 17.12.36, **35** (31), 44.—The heaviest string of casing to be run in the Rocky Mountains has just been cemented. This string, which is 7075 ft. in length, weighs 431,575 lb. It is 11¾ in., 61 lb. per foot casing, and special long couplings have been used.

L. V. W. C.

284. Operators can Contribute to Successful Cementing Jobs by Co-operating with Cement Firm. B. Mills. *Oil Weekly*, 4.1.37, **84** (4), 19.—Many failures generally attributed to the quality of the cement used in the cementing job or to the work of the cementing crew should be attributed to carelessness or errors in judgment on the part of oil companies. These failures could be overcome by a proper conditioning of the hole and a fuller co-operation between individuals in charge of the different concerns. L. V. W. C.

285. Compact Lay-Out of Rotary Rig for Deep Drilling. J. P. van Vorst. *Petr. Eng.*, Jan. 1937, **8** (4), 82.—A compact rig has been put into operation near Wickett, Texas. In this rig the hoisting gear, rotary drive, and cathead shaft, transmission and gas engines for power are all mounted on a structural steel frame. This rig is capable of drilling 12,000 ft. of 9-in. hole with 4-in. drill-pipe. The weight of the unit complete is 70,000 lb. L. V. W. C.

Production.

286. Sand-Tamped Well Shots Prove Successful on Flood Project. J. P. O'Donnell. *Oil & Gas J.*, 17.12.36, **35** (31), 47.—Sand tamping in shooting oil wells is being carried on successfully in the Clarendon field of Pennsylvania. This is the first occasion on which sand tamping has been used on an extensive scale in the eastern fields.

It has been found that three times as much initial production can be expected when a sand-tamped shot is used as results from the use of a water-tamped shot. The average cleaning-out period after a sand-tamped shot is from four to seven days, whilst a well shot with water-tamped shot can be cleaned out in one day and the casing run the next day. The length of the clean-out period indicates the size of hole made, and this shows the effectiveness of the shot. The more material is removed from the hole the more the sand has been opened up. Eighty quarts of glycerin are used by the operators in this area and a time bomb is used. L. V. W. C.

287. Many Factors Affect Production of Naphtha in Turner Valley. G. R. Elliott. *Oil & Gas J.*, 3.12.36, **35** (29), 32.—With the exception of a few west-flank wells in the Turner Valley district very large volumes of gas accompany the recovery of liquid products. The field has been controlled on a basis of gas quotas proportionate to each well's gas potential. The operator's present income is reduced by any reduction of the gas wastage and a rapid decline of reservoir pressure results from the requirements of gasoline plants, diversity of ownership and liberal gas quotas. The actual yield of liquid products is affected by reservoir conditions and back pressure, whilst other causes of variation affect the measured production or vary the relative proportions of naphtha and natural gasoline. L. V. W. C.

288. Results of Five Years Flooding in Nowata by Carter. P. Reed. *Oil & Gas J.*, 3.12.36, **35** (29), 43.—Water-flooding operations in the Nowata field, Oklahoma, by the Carter Oil Co., have furnished important data over a period of five years. The area covered is 125 acres, and in the course of the flooding project about 90,000 brl. of oil have been produced. A steady increase of production has resulted, although the production has not been large. From the curves given it is seen that the air-repressuring project which was carried out during 1927 and 1930 resulted in an increase in oil production. The cold weather at the beginning of each resulted in a sharp decline and reflected the difficulty in bringing back production after flooding had been temporarily stopped. Water is pumped into the input wells at the rate of about 2500 brl. a day with a line pressure of 400 lb. The greatest pressure used has been about 420 lb. The water is metered and oil production is gauged in test tanks and water production is recorded by pumpers' gauges. L. V. W. C.

289. Variety of Pumping Equipment Used in Central Michigan. T. P. Sanders. *Oil & Gas J.*, 10.12.36, **35** (30), 39.—A great variety of pumping equipment is to be found in the Michigan fields. The pay is usually at a depth greater than 3000 ft., and as a result most of the wells are individually pumped, the power usually being single-cylinder gas engines. Other types of power are, however, quite common. Most wells are equipped with an 80-ft. derrick and both wooden rig fronts and individual steel pumping units are in use. L. V. W. C.

290. Livermore Townsite Wells Pumped with Small Powers. T. P. Sanders. *Oil & Gas J.*, 10.12.36, **35** (30), 48.—Large quantities of oilfield supplies are needed in the Livermore field of Western Kentucky, although the completed depths of the wells are almost always less than 1400 ft. In addition, pumping equipment is needed very quickly

after completion on account of the short natural flow period. Two distinctly different types of pumping installations are to be found here; one in the populated areas of the city and the other in the open country. Small engines are used in the townsite to pump from one to four wells with short-rod lines. Large central power plants are impossible because the townsite leases are small. In the open country large central power plants are operated with long rod lines. L. V. W. C.

291. Conversion to Central Powers Reduces Operating Expense. M. Tucker. *Oil & Gas J.*, 3.12.36, **35** (29), 46.—Substantial economies have been made in the Haynesville field of northern Louisiana by the conversion of individually operated beam wells to various designs of multiple pumping arrangements. The units are centrally located between four wells either in line or approachable through the use of swings. Loads are completely balanced in these four well units. The initial cost of these units is low, and the engine and clutch troubles have been found to be very small. No counterbalancing is necessary with these units. L. V. W. C.

292. Ohio's Repressuring Project Increases Ultimate Yield. M. Tucker. *Oil & Gas J.*, 10.12.36, **35** (30), 32.—The usual objectives of repressuring, lower lifting costs, more rapid recovery and more complete recovery, have all been achieved in the Haynesville pool of N. Louisiana. It is estimated that, as a result of seven years of repressuring the Blossom sand, an increase of 3,500,000 brl. ultimate recovery has been achieved. A number of probable reasons why this area has responded so well to artificial gas drive are given. L. V. W. C.

293. Vacuum Plants Discourage Repressuring in Kentucky. T. P. Sanders. *Oil & Gas J.*, 17.12.36, **35** (31), 41.—The typical oil pool in Kentucky is operated by a number of operators, and vacuum systems are used on most leases. As a result repressuring operations are not readily undertaken by producers, in case those wells under vacuum should derive most of the benefit of the expenditure. It is likely, however, that vacuum on wells bordering a lease being repressured has less effect than is generally feared. It is agreed that repressuring is in every way an improvement on the old system of pulling a vacuum, but in those areas where the vacuum systems were shut down as soon as repressuring was commenced the production dropped until the effects of repressuring could be felt. The application of the vacuum has often resulted in large increases in production, but is accomplished only with the destruction of the natural reservoir pressure. L. V. W. C.

294. Gas Injection into Repressuring Wells Accurately Controlled by Two-Purpose Manifold. F. B. Taylor. *Oil Weekly*, 11.1.37, **84** (5), 38.—A two-purpose manifold for gas injection has been developed by the Greysolon Oil Co., and it is being used extensively. The hook-up effects control of input gas volumes through a one half-inch valve incorporated within a one half-inch supplementary manifold. The possibility of gas returning to the field repressuring lateral is eliminated by means of a check valve in the same manifold. The master injection manifold is of 2-in. pipe connected through the secondary manifold to the riser from the field lateral. The field pressure existing upstream from the injection manifold is determined by a valve-controlled bull plug. Orifice meters are placed in the line downstream from the pressure control, so that the pressure indicated is the actual input pressure. L. V. W. C.

295. Repressuring Increases the Ultimate Recovery of Small Field near Electra, Texas. J. C. Albright. *Oil Weekly*, 18.1.37, **84** (6), 28.—Repressuring has been applied with satisfactory results to a small field about a mile south-west of Electra in North Texas. Ultimate recovery has been considerably increased as a result of injecting gas into the producing sand over a period of five years. Eleven wells were drilled on the lease to the 550 ft. sand up to 1927, but the lease was considered to be practically depleted in 1931 when the total production was only 15 brl. daily. The gas used to repressure the lease was obtained from the Electra gasoline plant. Only the gas in excess of demand for other purposes has been used for repressuring.

A net gain of 40,066 brl. due to repressuring since 1931 is shown, so that the project has been a profitable one. L. V. W. C.

296. A Study of Bottom-Hole Flowing Pressures. S. F. Shaw. *Oil Weekly*, 11.1.37, **84** (5), 21.—Four main factors are recognized as being of major importance in influencing the flow of oil or in governing the rate of production. These are, pressure in the reservoir, permeability of the sand, condition of the well at the sand face, size of the flow string. The higher the reservoir pressure the greater the flowing pressure, even though the flowing pressure must always be lower than the reservoir pressure. Permeability and thickness of sand will govern the rate of flow through the sand and will have an influence on the flowing pressure. A large diameter at the face of the sand will reduce the resistance to flow into the well and so result in a larger capacity for a given differential between the reservoir and the flowing pressure. Where the sand face is choked with paraffin, mud, etc., there will be a reduced flow. The size of the flow string will affect the amount produced : the larger the diameter the larger the quantity produced. L. V. W. C.

297. Determining an Oilfield's Possibilities for Secondary Recovery. P. D. Torrey. *Petr. Eng.*, Jan. 1937, **8** (4), 65.—The author outlines topics for conducting a careful field study of conditions and practices prior to attempting to apply water flooding or other secondary recovery methods. L. V. W. C.

298. Corrosion-Resisting Flow String is Run. B. Mills. *Oil Weekly*, 11.1.37, **84** (5), 30.—In this string no metal is exposed to the fluid from top to bottom. The flow string is completely protected from the corrosive fluid produced in the Goose Creek area. The assembly consists of a cement-lined casing with bronze–lead seal, bronze packer, bushing, liner and screen. The assembly included 4085 ft. of 5-in. cement-lined casing and 247 ft. of 3½-in. bronze liner and screen. L. V. W. C.

299. Additional Research in Petroleum Emulsions should Prove Profitable. M. J. Leary. *Oil Weekly*, 4.1.37, **84** (4), 26.—Oilfield emulsions are formed only in the presence of a colloid, the water-in-oil type forming most readily in the presence of hydrophobic colloids, whilst oil-in-water emulsions form most readily in the presence of hydrophilic colloids. The film of oil enclosing the minute drops of water in the first type of emulsion is very tenacious, and the breaking of water-in-oil emulsions resolves itself into the removal of decomposition of the hydrophobic colloids or the rupture of the oil films.

Where the hydrophobic colloid present is asphalt, this asphalt may be removed by chemicals. In addition it is nearly always necessary to rupture the oil film encasing the individual water drops. Heat will cause the breakage of the film, as will violent agitation in the presence of large quantities of water.

Where electrolytes are present an electric current passed through the emulsion will readily break down the emulsion.

The addition of a hydrophilic colloid to an emulsion which already contains a hydrophobic colloid will cause the water drops to coalesce rapidly.

Liquid soaps are used for breaking oilfield emulsions.

Further research into the problems of making and of breaking emulsions in which petroleum comprises a part should be profitable. Small-scale tests should be carried out before the emulsion breaker is tried on the large scale. L. V. W. C.

300. Heaters for Crude-Oil Emulsions. W. Woelflin. *Petr. Eng.*, Jan. 1937, **8** (4), 41.—The advantages and disadvantages of the various types of crude-oil emulsion heaters are discussed.

High-pressure steam heaters are cheap to instal and maintain, and occupy only a small space, but the cost of the steam is high.

Steam heating of the emulsion in a tank is not considered good practice, owing to the possibility of the tank boiling over and to the loss of light fractions, except where the crude oil is heated to drop out sand or to reduce its viscosity for pumping, etc. Pumping the oil through a heater is preferred, a suggested type being one containing 184 tubes of ¾-in. O.D and 16-gauge of 80–100-ft. heating surface. Sediment is easily removed by opening the heads, which are baffled so as to give multipass.

Low-pressure steam heaters are generally made from old boilers and a heat exchanger, and are well suited to locations where boiler feed-water is expensive or corro-

sive. The installation is thus cheap, but the heater used must contain more heating surface, owing to the lower heat transfer rate, whilst steam and condensate return lines must be larger than when high-pressure heaters are used.

Coil-type boiler heaters are essentially the same as low-pressure steam heaters in which the heating coil is placed inside the boiler, and may be made up from old boilers by removing the upper half of the tubes and installing a new tube-sheet welded in to take the oil tubes. A baffled head is provided to cause the oil to make as many passes as possible through the heater. The advantages and disadvantages of this system are similar to those of the low-pressure steam heaters.

Heating efficiency data on specific plants of the type described are tabulated, it being stated that the coil-type heater should be more efficient than the low-pressure steam heater, as there is less surface for radiation to the surrounding air, the heating coil being immersed in the fluid inside the boiler. C. L. G.

Transport and Storage.

301. Reconditioning a 700-Mile Pipe-Line. F. H. Love. *Petr. Eng.*, Jan. 1937, **8** (4), 38.—A 700-mile-long 12-in. pipe-line carrying crude oil and (later) gas, originally laid in 1923 in highly corrosive wet alkaline soil and running from Welch, Wyoming, to Freeman, Missouri, has been recently reconditioned, owing to numerous leakages. 170 miles of badly corroded line were located in sections by a study of leak records and by a visual inspection of areas where corrosion was expected, due to surface indications. Such sections were uncovered and cut out in 20-ft. joints, which were sent to one of a number of centralized yards, where the pipe was cleaned, graded and the threads were trimmed. Corroded areas were spot welded and the welds ground smooth. Only a small percentage of the pipe was not salvaged, due to its corroded condition. The 20-ft. joints were electrically welded into 200-ft. sections, and these welded into the line. After machine cleaning and priming, the pipe was coated with $\frac{1}{32}$ in. of asphalt and asbestos felt wrapped spirally around, finishing off with a final coat of $\frac{1}{16}$ in. of asphalt. C. L. G.

302. Laying Gasoline Line under Susquehanna River. E. T. Wolf. *Pipe-Line News*, Oct. 1936, **8** (11), 7.—Illustrated description of laying an 8-in. gasoline line in the bed of the Susquehanna River, Harrisburg, Pennsylvania, at a point where the river is four-fifths of a mile wide. The river bottom at this point is largely composed of limestone, red sandstone, gravel, with some mud, coal silt and other sedimentary deposits. 530 6-in. holes were drilled through metal casings for a distance of 6 to 10 ft. in the rock, spaced 8 ft. apart across the river from shore to shore. The explosive loaded in them was 60% special gelatin in 5-in. by 24-in. cartridges. Charge in each hole was determined by the character of the material in the river-bed. In some instances 50 lb. sufficed, in others 125 lb. were needed; the average was about 75 lb. Cordeau fuse was employed as the detonating agent, and the primers were dipped in cap sealing compound to keep out water. This fuse, of the double-countered type, withstood the pressure of the strong river current without lines breaking from contacts with debris floating down the river. The use of fuse also minimized the possibility of electrical troubles, for only one electric blasting cap was needed to set off the charges in a long line of holes. About 100 holes were discharged at a time.

W. W.

303. Raw Rubber Coating Used to Prevent Pipe-Line Corrosion. L. E. Bredberg. *Oil & Gas J.*, 7.1.37, **35** (34), 37.—A pipe-line company in S. Texas is experimenting with pipe-line wrappings of 20 mils. thickness of raw rubber, the pipe being first thoroughly cleaned and all pits spot welded if necessary. Adhesive rubber cement is applied to the pipe, allowed to dry for 10 minutes and the rubber strips (6 in. wide) are wrapped round, each turn overlapping half the previous turn. Extra strips are built up around collars to prevent sharp edges damaging the rubber. A curing solution is applied and the coated pipe exposed to the air for 24 hours. After laying the line and back filling, the rubber coating takes 8 days to cure to the consistency of tyre rubber. Care must be taken to prevent oil leaking down to the coated line. In spite of the high cost of the coating, it may prove economical in highly corrosive areas. The pipe will be examined after an interval of 10 months. C. L. G.

304. Corrosion of Tubing in the Oil Industry. N. W. Mitchell. *Oil & Gas J.*, 29.10.36, **35** (24), 43; *Refiner*, 1936, **15** (12), 559.—An examination has been carried out of 63 cases of corrosion of tubing from condensers, reboilers, coolers and heat exchangers in the Mid-Continent and E. Texas fields. Details are given of the general causes of corrosion and of the results of several tests on different alloys.

It is calculated that 16 million lb. of condenser tube are in use in the oil industry, the average life being only 2 years, and thus replacement costs approx. $1,000,000 annually. Nearly 50% of the tubing used is of Admiralty metal, the remainder being various steels and ferrous and non-ferrous alloys. Of the 63 corrosion cases examined, 38 were of Admiralty metal, 14 having failed by dezincification on the water side and 12 by corrosion from acid or sulphur compounds on the vapour side.

Corrosion on the water side may be the result of galvanic action, differential aeration, or selective solution which results in dezincification in the case of brass alloys. Cu–Zn alloys containing 78% Cu are nearly immune to dezincification, red brass (85% Cu, 15% Zn) being particularly recommended as a substitute for Admiralty metal in cases of dezincification.

Heat-exchanger tubes of yellow brass sometimes fail by stress corrosion, the red brass alloys being practically immune.

Two-year tests on 35 alloy condenser tubes in corrosive water at 150° F. with oil vapours on the outside showed corrosion mainly on the water side, the yellow brasses having suffered dezincification. The red brass, the 70 : 30 and 80 : 20 Cu–Ni alloys and high arsenical brass showed practically no corrosion, whilst the high copper alloys (92 : 8 aluminium bronze, 95 : 1 : 4 Cu Mn Zn special alloy and 98 : 2 cupro-nickel alloy) were the only ones to fail on the vapour sides, the last-named failing rapidly by thinning from the vapour side. Laboratory tests showed that small amounts of arsenic in yellow brass prevent dezincification, but render it more susceptible to stress corrosion. Antimony gives protection from both types of attack, as is shown by the results of a further series of tests.

On the vapour side, resistance to corrosion from sulphur compounds is given by aluminium, but this is not suitable for condenser metal. High copper alloys are particularly susceptible to sulphur attack. Low copper aluminium bearing alloys are being tried, although the low copper renders the alloy susceptible to selective solution in water. It is felt that the most useful metal is Admiralty containing sufficient antimony to prevent dezincification, this having a similar resistance to sulphur corrosion to that given by Admiralty metal.

In view of the fact that high copper alloys resist water corrosion and low copper alloys sulphur corrosion, duplex tubes of commercial bronze and Admiralty metal, preferably containing antimony, are being tried out. Milling costs are not known, but they should not greatly exceed those of Admiralty metal. Trouble may also be experienced owing to differential expansion. C. L. G.

305. Effect of Soils on Asphalt used for Pipe-Line Coatings. D. R. Hiskey. *Pipe-Line News*, Oct. 1936, **8** (11), 4.—An examination of pipe-lines treated with asphalts shows that after a comparatively short period of time the outer surface of the asphalt becomes dull, and on continued exposure becomes brittle and will pulverize when rubbed between the fingers. Present-day asphalt can be said to be composed of bitumen and oil. When put in contact with a sandy or sandy-loam soil a capillary attraction is set up by the soil which draws the oil from the asphalt.

The Southern California Gas Company has made an extensive study of its mains and services, particularly relative to the conditions of the outer layer of asphalt. In a series of recent laboratory tests, pipe nipples were treated with the Company's standard coatings and placed in small test-boxes for accelerated corrosion tests. Over some of the nipples cellulose wrapping material was applied. After 90 days coatings protected by the cellulose material remained bright and glossy, the melting point of the asphalt being the same as initially, compared with an increase of from 185° to 208° F. in the case of the unwrapped test nipples. Tests are being continued with cellulose wrapping, for use in place of the usual kraft paper wrapping, and also with high-melting-point filled asphalt enamels. W. W.

306. Soil-Corrosion Studies, 1934. Rates of Loss of Weight and Penetration of Non-Ferrous Materials. K. H. Logan. *Bur. Stand. J. Res.*, 1936, **17**, 781–804.—This is a

progress report of the corrosion of non-ferrous materials, which study was not commenced systematically until 1932. Previous to that date a few such materials were included in the study of the corrosion of iron and steel commenced in 1922.

The latest tests concern only copper and copper alloys.

The work carried out previous to 1932 has led to no positive decisions, owing to its lack of system, but it has indicated some useful and practical tendencies.

The report summarizes the effect of a large variety of soils on many non-ferrous metals and alloys, data on iron subjected to the same conditions being added. In general, these materials, with the possible exception of aluminium and its alloys, corrode less than ferrous materials under similar conditions, but no material has been found free from soil corrosion.

In the choice of materials, soil conditions should be given consideration, and special knowledge of soils, metals, electrochemistry and economics is essential.

D. L. S.

307. Patents on Corrosion. Bataafsche Petr. Mij. E.P. 459,420, 7.1.37. Preparation of steel picklings inhibitors from the oily product obtained by neutralizing petroleum acid sludge.

G. M. Fisher. U.S.P. 2,068,979, 26.1.37. Prevention of corrosion in oil-stills by supplying to the oil a small proportion of calcium naphthenate. W. S. E. C.

308. Pipe-Line Reconditioning Practice. J. C. Albright. *Petr. Eng.*, Jan. 1937, **8** (4), 44.—The Standard Oil Company of California has adopted a definite method of pipe-line reconditioning which has been found to give satisfactory results over a number of years. The line is first inspected by electrical measurements where such facilities are available. If deterioration has progressed to a degree where leaks may develop within a short time, the section is stripped completely by hand scraping and sand blasting. Spot welding or patching is then done, and the primer coat is brushed on. The pipe is then wrapped with a bituminous paper. Where the condition of the pipe indicates that a strong current has been flowing along the line, ground wires are attached to dissipate it into the surrounding soil. L. V. W. C.

309. Proper Selection and Installation of Crude Storage Tanks will do much to Relieve Corrosion. J. P. Walker and C. D. Laidley. *Oil Weekly*, 11.1.37, **84** (5), 33.—When considering tankage for crude storage it is necessary to consider the service to which the tank is put and the material of which it is constructed. The factors entering into the service life and ultimate cost are, materials used, kind of tank, tank sites, salt water and acid disposal, and venting of corrosive gas.

The various materials and kinds of tanks are dealt with, as are the other factors, in some detail. Interior treatment against corrosion is briefly dealt with with some suggestions. L. V. W. C.

Gas.

310. A Gas Delivery Chart. C. J. Brown. *Refiner*, 1936, **15** (12), 580–581.—A seven-scale orifice meter chart is given to facilitate the solution of problems in connection with gas delivery. The scales give the size of orifice plate necessary to obtain a given delivery at a given pressure, the hourly extension value in various units, the cu. ft. per hour of gas for standard conditions and orifice size coefficients. G. R. N.

311. Dust-Proofing Natural Gas Compressor Stations. R. T. Powers. *Pipe-Line News*, July 1936, **8** (8), 7.—The dust-proofing of compressor stations has not been reduced to an exact science, nor is the necessity for dust-proofing universal. This article portrays the adverse operating conditions which have been experienced in the Texas Panhandle oil- and gas-fields during the severe dust storms of 1933–1935, points out the observed effect of the dust in personnel and equipment, outlines the protective measures which have been applied and suggests the ideal dust-protecting system. W. W.

312. Liquefied Gas Outlets Increased. M. J. Conway. *Nat. Petr. News*, 25.11.36, **28** (48), 25.—The increase in facilities for the distribution of liquefied gases has been responsible for a marked increase in their consumption. The total consumption in

1936 was 63,000,000 gallons, of which more than half was accounted for by industrial and miscellaneous uses. Liquefied propane appears to have the best future prospects as a commodity, since the gasoline industry will probably absorb increasing amounts of butane. Noteworthy developments have been achieved in the servicing of communities too small to justify the expense of coal-gas plants. In these circumstances liquefied propane is being put to every use to which coal-gas is put. Its industrial applications include direct firing, direct air heating, the heat treatment of metals, metal cutting and welding and as fuel for I.C. engines. Specifications are given for liquefied propane and butane. The price is given as 5 to 10 cents per gallon f.o.b. source of supply. H. G.

313. Patents on Gas. Fried. Krupp A.-G. E.P. 458,570, 22.12.36. Purification of producer and like gases. The dust is removed by separators and the gas is then chemically refined in filters filled with a mixture of active charcoal and potassium bisulphate.

H. Tropsch. U.S.P. 2,063,133, 8.12.36. Production of liquid hydrocarbons from normally gaseous paraffinic and olefinic hydrocarbons by cracking the gases in the presence of chlorine and under a pressure of 750 lb./sq. in.

P. Feiler. U.S.P. 2,063,596, 8.12.36. Thermal treatment of gaseous hydrocarbons for conversion to higher-boiling liquid hydrocarbons in vessels having metallic coatings; the latter are prepared by decomposing a volatile metallic compound inside the vessel. W. S. E. C.

Crude Petroleum.

314. Analysis of Crude Oil Produced Outside of the U.S. G. Egloff. *Oil & Gas J.*, 21.1.37, **35** (36), 51.—Analyses and properties of representative crude oils produced in Argentina, Syria, Albania, Greece, Turkey and Venezuela are tabulated. In the case of Argentina and Venezuela oils, the yields of straight-run gasoline of varying endpoint, kerosine, gas oil, topped crude and reduced crude are given together with the properties of these products. R. A. E.

315. Properties of Representative Crudes. G. Egloff. *Oil & Gas J.*, 27.12.36, **35** (33), 110.—Analyses are given of various crude oils and of the more important products obtained by their distillation. These include oil from the following sources: Iran, Burma, Bahrein Islands, Sumatra, Borneo (Tarakan), Sakhalin Island, Trinidad, Colombia, Morocco (Spanish) and Germany. Brief information on the producing areas and the capacity of the refineries in each country is also given. C. L. G.

316. Rumanian Crude Analyses. G. Egloff. *Oil & Gas J.*, 31.12.36, **35** (33), 102.—Analyses are given of the Moreni and Gura Ocnitzei crude oils (the two most important Rumanian crudes) and of the gasolines, kerosines and gas oils obtainable from them. The Moreni crude has a gravity of 36·0° A.P.I. and a sulphur content of 0·14% and yields 28% of 52 O.N. gasoline of I.B.Pt. 130° F., and E.Pt. 394° F. with 20% dist. to 218° F. The waxy crude yields a kerosine of S.G. 0·810, with 10%, 50% and 90% dist. to 180° C., 220° C. and 278° C. respectively, and a gas oil of S.G. 0·848 with 10%, 50% and 90% dist. to 280° C., 308° C. and 363° C. The non-waxy crude yields kerosine of S.G. 0·818 with 10%, 50% and 90% dist. to 160°, 187° and 255° C. respectively and gas oil of S.G. 0·869 with 10%, 50% and 90% dist. to 215° C., 256° C. and 310° C. respectively.

The Gura Ocnitzei crude has a gravity of 37·2° A.P.I., a sulphur content of 0·16%, and yields 29·5% of 54 O.N. gasoline of I.B.Pt. 128° F. and E.Pt. 392° F. with 20% dist. to 214° F. The waxy crude yields a kerosine of S.G. 0·811 with 89% dist. to 280° C. and a gas oil of 0·845 with 89% dist. to 350° C. The non-waxy crude yields kerosine of S.G. 0·816 with 94% dist. to 280° C. and a gas oil of S.G. 0·862 with 92% dist. to 350° C.

Hydrocarbon analyses of different types of gasoline from the two fields are also given. C. L. G.

317. Effect of Gravity on the Process Cost of Mid-Continent Crude Oil. W. L. Nelson. *Refiner*, 1936, **15** (12), 572–573.—Calculations based on a flat transportation rate of 10 cents/brl. and the prices of crude on 3rd September, 1936, show that whether

(*a*) topping, cracking, and reforming,
(*b*) topping and cracking,
(*c*) complete processing and converting to 25% lubs.,
(*d*) complete processing and converting to 50% lubs.,
(*e*) complete processing and converting to 100% lubs.,

the net profit in cents/brl. diminishes as the A.P.I. gravity rises. For instance, the net profit in (*c*) type of operation is shown to fall from 56 to 11 cents/brl. in the change from 25 to 45 gravity stock. The difference is less marked in cracking operations, but much greater in processing to 100% lub. oil. G. R. N.

318. Patents on Crude Oil. P. R. Herschman. U.S.P. 2,064,541, 15.12.36. Desalting of crude oils and breaking of crude oil emulsions by treating them with a mixture of bleaching powder and at least one of the following compounds—sodium perborate or peroxide or hydrogen peroxide. W. S. E. C.

Cracking.

319. Cracking and its Economic Significance. G. Egloff. *Refiner*, 1936, **15** (12), 544–548.—It is estimated that if the cracking process had not been developed, the crude oil requirements of the United States would have been about 1,227,000,000 brl. more than was actually used in 1935. There is a consequent saving of about $1,500,000,000, the capital cost of production and transportation of this amount of oil. Polymerization units now in operation or under construction will conserve about 53,000,000 brl. crude oil a year when they are in operation. The cracking process affects not only the motor fuel industry, but also lubricating oil manufacture in the development of new lubricating oils by catalytic gas polymerization. The chemical industry has benefited by the increasing use of anti-oxidants, dyes and colour stabilizers in treating cracked gasolines. The steel industry has been stimulated to develop new alloys of high corrosion resistance, creep strength and thermal conductivity, capable of withstanding high temperatures and pressures. Control instruments have been developed, which permit more centralized control, longer runs and larger yields. In furnishing high B.Th.U. gas in large quantities for enriching, re-cracking or use as liquefied gas, the cracking industry has considerably affected the manufactured gas industry. The fuel oil, coke and gas produced by cracking may be substituted for about 65 million tons of bituminous coal per year, or about 20% of that marketed during 1935. The economic consequences of cracking are further reflected in the industries, which employ its by-products as starting material, including the manufacture of alcohols, glycols, resins, plasticizers, pickling inhibitors from cracked acid sludge and sulphuric acid from hydrogen sulphide. G. R. N.

320. Some Characteristics of the Residue from the Cracking of Castor Oil. A. A. Vernon and H. K. Ross. *J.A.C.S.*, 1936, **58**, 2430–2433.—Castor oil was submitted to pyrolysis in a heated silica tube over the temperature range 300° to 750° C. Acrolein and heptaldehyde were removed and the iodine number, acetyl value, sap. value and acid value were all determined on the residue. The results indicated that at about 425° C. the glyceryl portion of the molecule is broken, its decomposition giving rise to acrolein. At 465° C. the acetyl value of the residue dropped markedly, indicating that the hydroxyl grouping of the castor oil disappeared at this point. This indicates the formation of heptaldehyde and undecylenic acid. The hypothesis was checked by submitting undecylenic acid to a similar pyrolysis and determining the iodine values of the residues obtained at various temperatures. With these results it was possible to calculate the iodine value of the castor oil residue at some given temperature, and the calculated iodine values agreed with those found by experiment, within the limits of experimental error. W. E. J. B.

321. Patents on Cracking. T. B. Prickett. U.S.P. 2,062,333, 1.12.36 Improved form of application of heat to convertors in catalytic reactions.

J. W. Packie and D. E. Stines. U.S.P. 2,062,375, 1.12.36. Method of distilling cracked distillates of low b.pt., in tubular heaters at low temperatures.

C. D. Lowry, Jr., and F. J. Skowronski. U.S.P. 2,064,842, 22.12.36. Refining of low-boiling cracked distillates by treatment with liquid SO_2 and cracking the raffinate formed. The extract is then introduced to the fractionating zone for fractionation.

W. S. E. C.

Hydrogenation.

322. Hydrogenation. F. S. Sinnatt, J. G. King and A. MacFarlane. *Ind. Eng. Chem.*, 1937, **29** (2), 133.—This article presents a review of the work carried out at the Fuel Research Station on hydrogenation, with special reference to coal. Experimental work on hydrogenation was commenced in 1923, in order to ascertain whether British bituminous coals could be readily converted to gasoline. Following a study of various catalysts, an experimental plant of 1 ton per day capacity was erected. The mechanism of coal hydrogenation has been studied with especial reference to the light it throws on coal constitution. Attention has also been directed towards the hydrogenation and treatment of low-temperature tars, the properties of which are described. The influences of pressure and temperature on the hydrogenation and cracking of the aromatic constituents of low-temperature tars are reviewed, with especial reference to naphthalene. A brief outline of Hall's work on the hydrogenation-cracking of naphthalene is given. Employing a continuous plant, the influence of temperature over the range 300° to 510° C., and pressure from 200 to 400 atmospheres, on the hydrogenation of tar, has been exhaustively studied. After hydrogenation above 370° C. the tar loses its black colour, turning brown, but remaining opaque; at 450° C. the product is transparent and has a pale yellow colour. Catalyst deterioration in this reaction is accelerated by increase of temperature of operation. A semi-technical-scale tar hydrogenation unit has been constructed, and the method of operation together with analyses of the raw and treated tars are given. Temperature conditions in the catalyst chamber and means for dissipating the heat of reaction are described.

H. E. T.

323. Coal Hydrogenation. M. Pier. *Ind. Eng. Chem.*, 1937, **29** (2), 140.—By use of catalytic destructive hydrogenation, fuels such as coal tar, petroleum and shale oil give high yields of products which are usually obtained from mineral oils. Practically the only by-product in the process is a certain amount of gaseous hydrocarbons, which, however, may be utilized in the process by conversion to hydrogen. Catalytic hydrogenation makes possible the production from the same raw material, by suitable adjustment of the operating conditions, of temperature and pressure, of various final products such as, fuel oil, lubricating oil, diesel oil, illuminating oil or gasoline. The process of catalytic destructive hydrogenation covers a wide field of application, since it can be accommodated not only to a great variety of raw materials, but also to the market situations obtaining at any time.

H. E. T.

324. Patents on Hydrogenation. H. E. Potts. E.P. 458,856, 28.12.36. Hydrogenation of carbonaceous substances at 380–550° C. and under pressures above 50 atmospheres. The catalysts used are preformed lead salts of formic acid or of organic sulphonic acids.

Aktiebolaget Separator Nobel. E.P. 459,142, 1.1.37. Separation of oil produced by hydrogenation by centrifuging in two stages.

H. E. Potts. E.P. 459,268, 5.1.37. Destructive hydrogenation of brown coal of high oxygen content in which the initial material is pretreated with sulphur vapour or volatile inorganic sulphur compounds free from oxygen, or volatile organic sulphur compounds.

H. E. Potts. E.P. 459,554, 11.1.37. Recovery of molybdenum or tungsten compounds used as catalysts by burning out at least the greater part of the carbonaceous sub-

stances at 600° C. and treating the residues with an aqueous solution of ammonium carbonate at elevated temperatures.

Ges. für Linde's Eismaschinen A.-G. E.P. 458,557, 22.12.36. Production of hydrogen by partial combustion of methane with oxygen.

H. E. Potts. E.P. 458,667, 15.12.36. Hydrogenation of carbonaceous substances at 360–550° C. and under 50 atm. pressure at least using 100–4000 C. metres H_2/ton of material.

J. Y. Johnson. E.P. 458,692, 24.12.36. Production of hydrogen by conversion of hydrocarbons by means of steam into CO and H_2 using a Cowper apparatus.

A. Szayna. U.S.P. 2,065,201, 22.12.36. Separation of asphaltic substances by hydrogenation of hydrocarbons. The stock is heated to 800° F. and under 100 atm. pressure in the presence of hydrogen; the resultant mixture is cooled to 200° F. and the two phases separated—namely, a relatively light liquid phase free from asphalt and a relatively heavy phase consisting of precipitated asphalt. W. S. E. C.

Refining and Refinery Plant.

325. Solvent Refining in England. Anon. *World Petroleum*, Oct. 1936, **7** (10), 546.—A description is given of the Duosol solvent extraction and Double Solvent dewaxing plant installed by Herbert Green & Co., Ltd., at East Halton, Lincolnshire. The plant is capable of producing 40,000 t.p.a. of finished solvent refined and dewaxed oils, 20,000 tons medium-grade oils, besides fuel oil, slack wax and other by-products.

Refining of the oil is effected with the aid of liquid propane and "selecto," and a description of the auxiliary plant is given. The paraffinic-oil extract is treated with clay in order to provide a finished oil of correct colour.

Dewaxing is effected by acetone–benzol, and descriptions are given of the operating procedure and the solvent recovery plant.

Sweetland filter presses are used for clay removal and Vallez rotary leaf presses for wax removal. A vacuum distillation unit is available for producing special products from the treated oils, and additional refining plant is available for special purpose oils.

Medium-grade oils can be prepared in an atmospheric distillation unit with which the refinery is equipped. The blending and barrelling plant is housed in a steel frame building 236 ft. by 26 ft., and is equipped with patent drum-filling and weighing machines. Auxiliary plant is described, and the advantages of solvent refined and dewaxed oils outlined. R. A. E.

326. Ancap Refinery in Uruguay. C. R. V. Garzon. *World Petroleum*, Oct. 1936, **7** (10), 541.—In order to comply with the terms of the crude refining monopoly, the A.N.C.A.P. began the construction of its refinery in 1935 at La Teja, Montevideo Bay. The refinery will treat an Ecuadorian crude of 0·8193 sp. gr. and sulphur content 0·05%, which yields on atmospheric distillation 38% gasoline, 19% kerosine, 12% gas oil and 30% fuel. The refinery comprises a topping unit having a daily capacity of 600 cu. m.; a Dubbs cracking unit having an annual output (325 days operation) of 30,780 cu. m. of gasoline; a unit for treating the cracked gasoline in liquid phase with clay; refining plant for doctor and soda treatment of gasoline and for acid treatment of kerosine; the necessary auxiliary plants. The topping unit consists of a Foster Wheeler furnace, atmospheric fractionating tower, etc. The cracking plant will utilize as feed the 30% fuel-oil bottoms from the topping unit, together with a little of the gas oil. Acid treatment for the gasoline from Ecuador crude is unnecessary.

Detailed descriptions of the various parts of the refinery plant are given and photographs are supplied. The construction is now practically completed. R. A. E.

327. High Octane Gasoline is Made in Soviet Refinery. Anon. *Oil & Gas J.*, 31.12.36, **35** (33), 87.—A highly modernized refinery has been constructed at Ufa in the foothills of the Ural mountains to produce high-grade gasolines, diesel oil, fuel oil and road asphalt from the local Sterlitamak high-sulphur crude oil, which is similar to light Mexican or W. Texas crude. The crude is of 30·1° A.P.I. gravity, and contains 3%

of sulphur and has an I.B.Pt. of 110° C. with 30%, 40%, 50% dist. at 432° F., 568° F. and 672° F. respectively. Straight distillation only would produce a low-grade gasoline of 48 O.N. and 0·5% sulphur. The refinery, designed to handle this crude, included a two-stage topping unit, a two-stage cracking unit with separate reforming capacity, a two-stage re-run unit with centrifugal acid-treating plant and a complete doctor sweetening and recovery unit. The plant processes 12,000 brl. per day of Sterlitamak crude, being designed to produce maximum yields of motor gasoline and steam-distilled asphalt. A gas plant has also been installed to recover propane, butane, propylene and butylene for a polymerization plant to be installed later. The plant is highly flexible, and each unit can be independently operated.

From the atmospheric stage distillation unit, gasoline, reforming naphtha, gas oil and bottoms are taken off, the latter being then run to the vacuum unit where two gas oil fractions and specification asphalt are made. Alternatively, the crude bottoms may be passed to the cracking unit. The tube still is of the latest Alco design, with separate sections for the atmospheric and vacuum stage with a common convection bank. Maximum use is made of heat exchange throughout the distillation and cracking units. The reforming unit operates on the naphtha, which is first flashed to remove a small percentage of high O.N. gasoline. The reformed distillate is stabilized, the volatility being increased by using the stabilizer to run the gasoline recovered by absorption from the cracking unit. The cracking units consist of a vapour-phase cracking coil operating on gas oil and a viscosity breaking unit operating on reduced crude. The bottoms from the reforming and re-run units are combined with the gas oil and introduced into the main fractionating tower, the entire charge being thus heated by the ascending vapours. The three-coil design gives maximum flexibility and strips the straight-run fuel separately from the cracked fuel. Where temperatures reach 500° F. or above, the unit is constructed of special alloy steel to reduce corrosion. The stabilized gasoline distillates are acid treated in a three-stage centrifugal separation plant from which the sludge, after dilution and removal of oil, passes to an acid recovery plant. After water-washing and neutralization with caustic soda, the distillates are re-run, the gasoline collected being the doctor treated. High octane gasoline (75 O.N.) and motor gasoline (O.N. 69–70) are produced, of sulphur content below 0·1% and colour 21 Saybolt. The asphalt produced is of penetration 50–150 at 77° F.

C. L. G.

328. New Type Two-Stage Vacuum Unit at Bucuresti Refinery. Anon. *Oil & Gas J.*, 31.12.36, **35** (33), 102.—A two-stage vacuum crude unit has recently been installed at Bucuresti, Rumania, to handle 3600 brl. a day of asphaltic or paraffinous crude. It is so designed that with the addition of another furnace and a reaction chamber it can be converted into a combination crude and two-coil cracking unit. Typical yields on the atmospheric unit are: light benzine 5·1%, medium benzine 10·99%, heavy benzine 4·30%, white spirit 9·65%, kerosine 5·75% and gas oil No. 1 19·04%, whilst the vacuum unit yields gas oil No. 2 0·35%, light lub. oil 15·19%, heavy lub. oil 5·17% and asphalt 15·20%, 8·46% representing loss and fuel burned.

After preheating the crude is passed through a salt settling-drum and then to a preflash fractionating column where a light gasoline overhead is taken off and the balance passed to the atmospheric fractionating column. The bottoms are pumped after heat exchange to the vacuum side of the dual furnace, half the steam being put into the tubes before the oil leaves the furnace and the remainder into the flash section of the vacuum tower. The vacuum column is divided into sections at different pressures, the top at 30·35 mm. and the bottom at 10·15 mm., so as to ensure complete stripping of the asphalt bottoms. A flow diagram of the vacuum unit is reproduced.

C. L. G.

329. Sulphur Recovery Unit at El Segundo. L. P. Stockman. *Oil & Gas J.*, 22.10.36, **35** (23), 46.—A refinery at El Segundo (S. California) recovers the sulphur from the H_2S eliminated from the cracking still gases, by absorption of the gases in sodium phenolate followed by liberation of the H_2S by steam activation, the H_2S being burnt to produce sulphuric acid. The high-pressure absorption plant has a capacity of 13 million cu. ft. of gas containing 4·5% of H_2S, and the low-pressure plant one of 3,600,000 cu. ft. of similar gas, 95% of total H_2S being removed. In order to purify

the H_2S, a degassing drum is provided between the absorbers and the activator, giving a purity of 96%. The cost of sulphur delivered by the plant as acid is materially less than the cost of brimatone. Corrosion difficulties are countered by the use of 18:8 stainless steels. C. L. G.

330. Plate Efficiency and Entrainment in Distillation. F. H. Rhodes and P. G. Slackman. *Ind. Eng. Chem.*, 1937, **29**, 1, 51.—If it is assumed that the Murphree efficiency is independent of reflux ratio, it is possible by carrying out determinations of actual plate efficiency at two different reflux ratios to obtain values for the Murphree and entrainment efficiencies. The method was applied to an experimental column using ethanol–water and benzene–toluene mixtures. It was found that the Murphree efficiency was independent of the concentration of the liquid on the plate. With benzene and toluene the entrainment is less with liquids containing 60 to 70 mol.-% of benzene than with mixtures richer or poorer in benzene. Dilute mixtures of alcohol in water give high entrainments: above 30% alcohol the entrainment is small. P. D.

331. The Pennzoil Contact Filtration Unit. J. C. Albright. *Refiner*, 1936, **15** (12), 555–558.—The continuous Filtrol unit of the Pennzoil Co. for clay treatment of bright stocks and steam-refined lubricating oils is described. The clay used is of 200 mesh and is shipped in bags from Mississippi and California. The bags are opened by hand, then the clay is mechanically conveyed in a closed system to storage bins, from which it is fed by gravity to a mixing tank via an electrical weighing-machine. In the tank a slurry is made with the unrefined oil and is passed to the atmospheric pipe-still, where it mixes with the bulk of the oil. The oil-clay slurry is flashed in a dephlegmator, and light and intermediate fractions are removed. The bottoms, after steam processing, are pumped to an accumulator tank, which in turn feeds a filter press in which the clay and oil are separated at 325–350° F. The spent clay is removed from the press every three hours and used as a road-surface material. The clay-treated oil is then transferred to the centrifuge section for dewaxing. G. R. N.

332. Freedom's Chlorex Plant. J. C. Albright. *Refiner*, 1936, **15** (12), 570–571.—The chlorex extraction plant at Freedom, Penna., has been in operation for more than a year, processing the usual Penna. steam-refined cylinder stocks and overhead neutrals, chiefly the former. For the cylinder stocks the solvent–oil ratio is 1·5 : 1 at an extracting temperature of 75–80° F. An average stock (164 S.U. viscosity at 210° F.) yields 94·4% raffinate (155 S.U. viscosity at 210° F.) and 5·6% extract (625 S.U. viscosity at 210° F.). For the overhead neutrals the solvent–oil ratio is 0·5 : 1 at 70° F., and a charge of V.I. 105 gives a 95·54% raffinate of V.I. 112 and a 4·46% extract of V.I. −20. To date the plant loss of chlorex is of the order of 0·6%. G. R. N.

333. Engineered Methods for Cleaning Equipment. H. L. Gray. *Petr. Eng.*, Jan. 1937, **8** (4), 97.—Systematic standardized methods of cleaning process equipment have been drawn up after an intensive study covering laboratory research to develop effective cleaning materials and mechanical and field study to develop efficient cleaning methods. The operations for cleaning production, refinery and distribution equipment have been classified, bearing in mind the practical requirements in each case, *e.g.* safety, economy, time saving, improvement in refinery yield and quality of product. An example is given of the method developed for cleaning heat exchangers requiring a large pump, an open solution tank in which to mix the cleaning material and the necessary piping and steam connection valves. The process developed embodies (*a*) frequent reversal of the flow of cleaning solution, (*b*) provision of steam injection for breaking up and removing deposits, and (*c*) the use of a settling drum before the cleaning solution returns to the tank. This method requires much less labour than that required for cleaning by dismantling, and is more thorough. Less wear and tear on the equipment is caused, and the method is not only cheaper, but also enables the heat exchanger to be put back into use in a much shorter time. Other methods worked out include those for water-jackets of diesel engines, compressor-jackets and air-filters for compressors. C. L. G.

334. Progress in Metals. W. L. Nelson. *Oil & Gas J.*, 14.1.37, **35** (35), 58.—*Subzero Steels for Propane Dewaxing.*—The austenitic high nickel steels and several non-ferrous alloys are particularly suited for the construction of pressure vessels for use in solvent dewaxing plants, but are too expensive and difficult to fabricate for large vessels. A nickel steel of the following composition: C 0·2–0·3%; Si (min.) 0·25%; Mn 0·5–0·8%; and Ni 2–2·5%, has been selected for use in California, and is stated to be capable of being economically rolled in large-size plates. The following minimum specifications were required: Tensile strength 70,000 lb. per sq. in., yield point 40,000 lb. per sq. in., elongation in 2 in., 30%, Charpy impact at −50° F. 15 ft.-lb.

Cast nickel steel also retains its toughness at low temperatures, and is suitable for the manufacture of castings for refrigeration equipment and low-temperature pumps for use at −75° F.

Non-sparking Tools.—The use of beryllium copper alloys for the manufacture of non-sparking tools is justifiable in spite of their higher price, in view of their comparable qualities to tool steel. The 2·15% Be alloy has a tensile strength varying from 70,000 to 190,000 lb. per sq. in., depending on the heat treatment and amount of working that the alloy has undergone, and a Brinell hardness of 110 to 360. The alloys also possess the corrosion resistance of all copper base alloys.

Metallurgical Terms.—Definitions are given of the tensile strength and elastic limit or yield point of metals, it being emphasized that the elastic limit is the more useful figure for engineers and steel-users. A table of tensile strengths and yield-points of various steels and alloys illustrates the indication of the ductility of the metal given by the ratio between the two figures. C. L. G.

335. Patents on Fuel Oil. C. E. Lauer, R. E. Manley and H. D. Loeb. U.S.P. 2,064,549, 15.12.36. Production of merchantable fuel oil by treating acid-oil sludge from the acid treatment of oil.

A. J. Kraemer. U.S.P. 2,065,281, 22.12.36. Improvement of residual fuel oils containing lime from cracking operations by adding the acid oil separated from the acid sludge to render the calcium compounds inert. W. S. E. C.

336. Patents on Wax. E. W. Fawcett and I.C.I., Ltd. E.P. 459,540, 11.1.37. Refining of natural waxes by high vacuum distillation. W. S. E. C.

Chemistry and Physics of Petroleum.

337. Physical Properties of Olefin Hydrocarbons. W. L. Nelson. *Oil & Gas J.*, 7.1.37, **35** (34), 52.—A table is presented of the following physical data on the olefin hydrocarbons from ethylene to eicosene ($C_{20}H_{40}$): molecular weight, specific gravity, boiling point, melting point, heat of fusion, heat of combustion, critical temperature and critical pressure. C. L. G.

338. Heat Capacities and Entropies of Organic Compounds. Tetramethylmethane. J. G. Aston and G. H. Messerly. *J.A.C.S.*, 1936, **58**, 2354–2361.—The authors have determined the heat capacities of tetramethylmethane from 13° K. to the boiling point (282·61° K.) and the vapour pressure from the melting point (256·53° K.) to the boiling point. The molal entropy of the ideal gas at the boiling point calculated out at 71·71 ± 0·3 e.w. The authors have also calculated the "spectroscopic" entropy from the Raman spectrum. W. E. J. B.

339. Thermal Data on Organic Compounds. XVII. Heat Capacity, Entropy and Free Energy Data for Five Higher Olefins. G. S. Parks, S. S. Todd and C. H. Shomate. *J.A.C.S.*, 1936, **58**, 2505–2508.—The five olefins concerned were *n*-heptene-1, 1 : 4-pentadiene, tetramethylethylene and the two *diiso*butylene isomers. Data obtained included specific heats from 80 to 298° K., heats of fusion, calculated entropies in the liquid state at 298·1° K., and, except in the case of tetramethylethylene, the corresponding free energies. Among the α olefins the free energy difference between an olefin and the corresponding paraffin is uniformly about 21,000 calories. As the number

of radicals attached to the carbon atoms of the ethylenic linkage increases, this free energy of dehydrogenation falls off progressively to about 17,000 calories as a limit.
W. E. J. B.

340. Sodium Naphthalene. Preparation of Addition Compounds of Alkali Metals and Polycyclic Aromatic Hydrocarbons. N. D. Scott, J. F. Walker and V. L. Hansley. *J.A.C.S.*, 1936, **58**, 2442–2444.—The reaction of aromatic hydrocarbons with sodium is greatly facilitated by employing dimethyl ether or dimethyl glycol ether as the solvent, in place of diethyl ether. To such an extent is this the case that such hydrocarbons as naphthalene and diphenyl can be converted easily into sodium compounds. The paper describes the preparation of sodium naphthalene solutions.
W. E. J. B.

341. Vapour-Phase Hydration of Ethylene. R. H. Bliss and B. F. Dodge. *Ind. Eng. Chem.*, 1937, **29** (1), 19.—The vapour-phase hydration of ethylene to ethanol by catalytic means has been studied in order to arrive at a reliable value for the equilibrium constant of the reaction, previous calculations of the equilibrium constant by thermodynamic methods having yielded a result in variance with experimental values. This research presents values for the equilibrium constant Kp, for the vapour-phase hydration of ethylene at 7 to 11 atmospheres pressure, and 320°, 350° and 378° C., together with some new observations on catalysts. Twenty-one catalysts were investigated (methods of preparation recorded in detail), the method of determining catalytic activity being to investigate the reverse reaction—namely, the dehydration of ethanol, at atmospheric pressure and at 300° C., with flow rates sufficiently high to ensure that equilibrium was not attained. Various conclusions on catalytic activity and stability are recorded.

For the evaluation of the equilibrium constant a dynamic method was employed; ethylene and water vapour were passed over the catalyst under investigation at an elevated temperature and moderate pressure; the liquid products were condensed, weighed and analysed, while the gaseous products were metered and analysed. Further, precautions were taken to ensure that "polymerization of ethylene" did not occur, since the value for the equilibrium constant thus obtained would be valueless. The results obtained agree well with those of Stanley, Youell and Dymock, and both sets may be represented by the equations

$$\log_{10} Kp = 2100/T - 6170$$
$$\Delta F^\circ = 28{\cdot}20T - 9600$$

which refer to the reaction

$$C_2H_4(g) + H_2O(g) = C_2H_5OH(g).$$
H. E. T.

342. Liquid–Liquid Extraction. K. A. Varteressian and M. R. Fenske. *Ind. Eng. Chem.*, 1936, **28**, 1353.—Mathematical formulæ are developed for the solution of problems, in connection with single-stage extraction, co-current multiple and infinite stages, and counter-current multiple and infinite stages. As an example, the ternary system chloroform–water–acetic acid is selected, and a materials balance calculated by means of the formulæ developed for the various types of extraction.
J. W. H.

343. Ebulliometric and Tonometric Study of Normal Aliphatic Alcohols. M. Wojciechowski. *Bur. Stand. J. Res.*, 1936, **17**, 721–726.—The normal boiling points and coefficients of increase of boiling point with increase of pressure $\frac{dt}{dp}$, expressed in °C/mm. mercury, have been determined for five normal aliphatic alcohols by means of Swietoslawski's ebulliometric technique and the comparative method of measurements using water as a reference liquid. The following data were obtained for the highly purified alcohols. Methanol, b.pt. 64·509° C., $\frac{dt}{dp} = 0{\cdot}0331$; ethanol, b.pt. 78·325° C., $\frac{dt}{dp} = 0{\cdot}0334$; *n*-propanol, b.pt. 97·209° C., $\frac{dt}{dp} = 0{\cdot}0344$; *n*-butanol, b.pt. 117·726° C.,

$\frac{dt}{dp} = 0{\cdot}0372$; *n*-amyl alcohol, b.pt. 138·06° C., $\frac{dt}{dp} = 0{\cdot}0402$. Beginning with *n*-propanol, the introduction of a CH_2 group into the molecular chain increases $\frac{dt}{dp}$ by a constant value of 0·0029—the same amount as in the case of aliphatic hydrocarbons. D. L. S.

344. Heat of Hydrogenation of Ethylene. F. D. Rossini. *Bur. Stand. J. Res.*, 1936, **17**, 629–638.—The heat of hydrogenation of C_2H_4 to form C_2H_6 has become important in recent years, both scientifically and industrially. Unfortunately, extremely discordant values have been reported, two modern results differing by 7%.

From the value for the heat of combustion of C_2H_4 recently obtained by Rossini and Knowlton, and the values previously obtained by Rossini for the heats of combustion of C_2H_6 and H_2, a new value has been deduced for the heat of hydrogenation of C_2H_4.

The earlier calorimetric data are reviewed, there being now available five completely independent sets of data besides one value derived by Teller and Topley by a combination of statistically computed entropies with the free energy determined experimentally.

The following values for the heat of hydrogenation $-\Delta H°$ at 25° C. for the reaction $C_2H_4(g) + H_2(g) = C_2H_6(g)$ in kilocalories per mole have been obtained from this earlier work. Thomsen (1873–86) 32·3 ± 1·5; Berthelot and Matignon (1893), 37·6 ± 1·9; Von Wartenberg and Krause (1930), 30·6 ± 0·4; Kistiakowsky, Romeyn, Ruhoff, Smith and Vaughan (1935), (*a*) 32·58 ± 0·06, (*b*) 32·64 ± 0·06. The National Bureau of Standards (1931–1936) have now deduced a value of 32·78 ± 0·13.

The value of $-\Delta H°$ obtained by Teller and Topley appears to be low by from 1·6–1·7 kilocalories per mole. Explanations of this discrepancy are briefly reviewed. D. L. S.

Analysis and Testing.

345. Apparatus for the Fractional Distillation of Liquefied Gases. A. Rose. *I.E.C. Anal.*, 1936, **8** (6), 478–483.—A relatively inexpensive and simply constructed apparatus is described that gives a boiling-point curve that is smooth and independent of all reasonable variations in condenser temperature and heat input to the still. It consists of a packed glass fractionating column (310 mm. × 6·3 mm.) fitted with a 25-ml. still and a condenser, which is kept cold by placing it in a large Dewar flask (50 × 620 mm.). The condenser of the column is cooled by passing liquid air or cold air through it. The cold air coming from the condenser is passed through the length of the Dewar flask, and thus keeps the entire apparatus in an environment suitable for operation. The packed section is surrounded by a closely fitting but not actually sealed outer jacket, which creates a dead air space. The column is designed for total condensation, the product being taken off as gas through a side-arm; variations of pressure in the column are therefore eliminated. The condenser is purposely constructed with a large heat capacity, so that its temperature cannot change rapidly or suddenly. A semi-automatic device controls the rate of liquid air to the condenser, so that the temperature of the latter is kept between narrow limits. The column has about ten theoretical plates, a hold up of 0·6 to 1·2 ml. is passing down the column with an equivalent amount of vapour ascending. The product is usually taken off at rates of 5 to 25 mls. gas per minute. The liquid air requirement is 500 mls. per hour. Full details of construction and operation are given, as well as data on ethane–ethylene–methane and a propylene gas. G. R. N.

346. Variable-Volume Vapour-Pressure Apparatus. E. M. Barber and A. V. Ritchie. *I.E.C. Anal.*, 1936, **8** (6), 472–476.—The apparatus described is of the barometric type, and is intended to give more accurate information than that obtained with the Reid apparatus on the vapour pressure from zero to some intermediate per cent. evaporated of gasolines and naphthas. It consists of two glass tubes joined to a levelling bottle. The longer tube (220 cm.) is graduated in millimetres over 200 cm. length, and is open at the top. The second or burette tube is closed at the top with a

three-way stopcock connecting with an overflow receiver and the sampling bottle. The burette tube is made of alternate long narrow sections (30 cm. × 1 cm.) to obtain accurate readings of the liquid volume and bulbous sections (15 cm. × 3 cm.) to accommodate a relatively large vapour volume. The apparatus is placed in a thermostat, and readings of the meniscus are made by a cathetometer. Using liquids of known vapour pressure, it was found that the apparatus gave values not more than 2 mm. different from accepted values. Tests on reproducibility of the results showed it was essential to sample the liquid to be tested under standard conditions, *i.e.*, by water displacement. Experiments on the weathering of gasolines showed that the evaporation losses could be correlated with the vapour pressure-per cent. evaporated curve given by the apparatus. Similarly, the vapour locking characteristics of a gasoline can be expressed by establishing a curve between the vapour to liquid volume ratio and the boiling temperature which is obtained from the vapour-pressure measurements. G. R. N.

347. Direct Determination of Oxygen in Organic Compounds Containing Sulphur. W. W. Russell and M. E. Marks. *I.E.C. Anal.*, 1936, **8** (6), 453–455.—Having previously found that their modification of the ter Meulen method of direct determination of oxygen in organic compounds by catalytic hydrogenation gave satisfactory results with oils the sulphur and nitrogen content of which was below 0·1%, the authors have applied it to several types of organic sulphur compounds to examine the question of the poisoning of the catalyst. As a result of this examination they recommend the use of a quartz-supported, thoria-promoted nickel catalyst for the determination. G. R. N.

348. Oil Acidity Pipette. W. F. Davidson. *I.E.C. Anal.*, 1936, **8** (6), 483.—A double pipette is described for use in determining the acidities of a number of inspection samples of used transformer oil. This pipette obviates weighing of each sample, and has the property of self-rinsing, since the benzene–alcohol solvent is drawn into the upper bulb and washes the sample of oil from the lower bulb when transferred to the titration flask. G. R. N.

349. Significance of Various Laboratory Tests Used on Motor Fuels. A. W. Trusty. *Oil & Gas J.*, 24.12.36, **35** (32), 34.—The gravity of commercial fuels of similar volatility and octane rating ranges from 55° to 65° A.P.I. The test has little significance, and is rapidly being dropped from specifications. The copper-strip corrosion test reveals the presence of any corrosive compounds, and should be included in specifications in order to avoid corrosion of parts of the fuel feed system. The doctor test is a method of detecting H_2S or mercaptans. If corrosion test is specified, the only value of the doctor test is to ensure the sweet odour of the product. The present U.S. Government Specification of 0·1% max. total sulphur has received criticism. Gasolines with 0·3% sulphur are sold in Germany and England, and no harmful effect has been observed. High sulphur gasolines can be used without harm in warm climates. Road work indicates that a maximum preformed gum content of 10 mgm. is sufficient to ensure freedom from deposition of gum on valves and in the feed lines of the motor. The induction period test and copper dish test used in conjunction give indications of the tendency of a gasoline to form gum in storage. The modern automobile engine requires a gasoline of high octane number. Factors affecting detonation and advantages of using high compression ratios are discussed. Attention is directed to the fact that too high an octane rating will actually decrease power output if the compression ratio is not increased to take advantage of the potential value of the fuel. Contrary to popular belief, differences in economy between fuels are small, as compared with differences in performance and possibility of injury to the engine or fuel induction system. Volatility is one of the most important properties of a motor fuel, and should be such that the fuel (1) is able to start the engine easily, (2) gives rapid acceleration without the use of the choke, (3) gives good power or mileage, (4) should not be so volatile as to cause vapour lock, (5) should not give excessive crankcase oil dilution. Results of research carried out by Brown and Brooks correlating the performance of a gasoline in respect of factors (1), (2) and (3) with the A.S.T.M. boiling range are quoted. With regard to vapour lock, the presence of more than small amounts of

propane in motor fuels is undesirable. It is also undesirable that the 10% distillation temperature should be much lower than is consistent with easy starting properties. The lowest practical temperature for fuel in the fuel lines of most automobiles to ensure easy starting and good warming-up characteristics is 110° F. Vapour locking temperatures for gasolines are shown in relation to Reid vapour pressure at 100° F.

A motor fuel need not be completely vaporized in the induction system in order to function efficiently, but the dewpoint is the controlling factor in determining the amount of crankcase oil dilution under given conditions of weather and engine. This dilution does not affect the fuel consumption appreciably, but may so thin the lubricating oil as to give rise to excessive oil consumption, wear or injury to the engine. If the use of the choke during starting is limited to the bare minimum, no trouble from crankcase dilution will be experienced with present-day fuels. The important points to cover in specifications for motor fuels in respect of volatility are therefore the 10%, 50% and 90% distillation temperatures and the vapour pressure.

R. A. E.

350. High-Temperature Expansion of Petroleum Fractions. K. M. Watson, E. F. Nelson and G. B. Murphy. *Oil & Gas J.*, 12.11.36, **35** (26), 85.—Methods have been developed for predicting the specific volumes of liquid petroleum fractions, both cracked and straight run, at temperatures up to the critical. An instrument of heavy glass like an inverted thermometer was used, pressure being applied at the lower end by its connection to a mercury-filled cylinder operated by a screw and hand wheel. Oil is placed in the top of the tube and heated in a quickly removable electric furnace, the volume of oil in the tube being measured on a calibrated scale by a cathetometer. Readings were taken over a range of 400° F. to 800° F. and from 0 to 1200 lb. per sq. inch., corrections being applied for the thermal expansion of the glass. It was found that with paraffin straight-run and cracked fractions of the same gravity, but with widely different viscosities, the lighter cracked fractions had very much higher coefficients of expansion. Methods for correlating the expansion data against physical properties such as gravity, boiling point, U.O.P. characterization factor, critical pressure, etc., are discussed.

C. L. G.

351. Composition of Yates Gasoline. C. O. Tongberg, M. R. Fenske and J. E. Nickels. *Ind. Eng. Chem.*, 1937, **29** (1), 70.—A fractional distillation of 45 gallons (170 litres) of a Yates straight-run gasoline run in a standardized manner yielded considerable information regarding its constitution. The fractionation was carried out in a column which had the equivalent of 70 to 75 theoretical plates when tested under total reflux with a mixture of *n*-heptane and methyl*cyclo*hexane. The gasoline was divided into 180 fractions, each fraction consisting of 0·3 to 0·6% of the charge. The gasoline was found to differ from other gasolines of paraffin type. A detailed study of the fractions obtained indicated that the gasoline consists mainly of naphthenes and branched-chain paraffins. Among the hydrocarbons separated and identified were methyl-*cyclo*hexane and ethyl*cyclo*hexane; no normal paraffins were identified. Aromatic hydrocarbons were present in only negligible quantities below 157° C. Certain fractions with a lower refractive index and density than other fractions had higher octane numbers.

H. E. T.

352. Hydrocarbons in the Fraction of a Mid-Continent Petroleum Distilling between 115° and 124° C. R. T. Leslie. *Bur. Stand. J. Res.*, 1936, **17**, 761–769.—Previous papers described the separation of *n*-octane, 2-methylheptane and a dimethyl*cyclo*hexane fraction from a mid-continent petroleum distillate boiling between 115° and 126° C. The methods evolved to isolate these three types of compound have been used to study the considerable material remaining.

Systematic distillation and crystallization revealed large quantities of paraffinic constituent in the distillate 116–118·5° C. Mixed melting points and photomicrographs showed that this material was practically identical with a hydrocarbon isolated earlier, and further tests indicated that it was probably 2-methylheptane.

Four fractions distilling in the region 119·2–124° C. were found to be naphthenic and were crystallized repeatedly, whilst physical properties, cooling curves and photomicrographs were studied. Synthetic samples of *p*- and *m*-dimethyl*cyclo*hexanes and

their mixtures were also studied. The fraction 119·2–120·8° C. contained additional quantities of two naphthenic hydrocarbons which had been isolated before and from a study of the crystal types, also probably *m*-dimethyl*cyclo*hexane. A fraction 112–124° C., besides showing the characteristic crystal behaviour of the unidentified constituent, also showed the presence of a small quantity of a paraffinoid hydrocarbon.

It was estimated that the petroleum contained about 0·5% of 2-methylheptane, 0·2% of *cyclo*hexanes distilling between 119·2° and 120·8° C. and 0·04% of the *cyclo*hexane boiling at 123·4° C. D. L. S.

Motor Fuels.

353. High Octane Fuels. E. L. Bass. *Aircraft Engineering*, Jan. 1937, **9** (95), 13.—The various requirements which an aviation fuel should satisfy are discussed and given as follows: high anti-knock value, adequate supplies, reasonable cost, physical characteristics to be such as to enable the fuel to be used in conventional carburettor systems, calorific value on a weight basis to be as high as possible, storage stability, water stability, minimum water solubility, good lead susceptibility, and low freezing point. It is stated that *iso*-octane satisfies most of these requirements, and if blended with a volatile petroleum spirit, all the requirements can be met. The value of lead tetraethyl as an anti-knock dope is stressed.

In the utilization of high octane fuels it is shown how the power output can be increased and how the specific weight and fuel consumption can be reduced by increasing the compression ratio and supercharge pressure. The economics of high octane fuels in civil aviation is discussed and an analysis is given which shows under what conditions a saving will be effected by their use.

The available engine test methods are criticized and the efforts to correlate with full-scale bench tests are described. It is pointed out that modern high-speed indicators are useful in detecting detonation, and, if simplified, should help to solve the problem of knock testing. Some suggestions are given for the better correlation of laboratory test engines with aircraft engines under service conditions.

The author concludes that: (1) in spite of the increased cost of 100 O.N. fuels, their use for civil aviation can be fully justified; (2) to use 100 O.N. fuels to the best advantage, new engines of increased strength will be required; (3) an advantage will be gained by the use of some form of mixture tester to enable the weakest permissible mixture strength to be used under cruising conditions and at the same time to avoid running into too weak a mixture; (4) the rating of fuels of 100 O.N. demands immediate investigation, which will involve new correlation work with the C.F.R. engine. The investigation of an alternative method of measuring detonation to the bouncing pin should be undertaken, and consideration should be given to the rating of fuels at two mixture strengths corresponding to cruising and take-off conditions.

J. G. W.

354. Fuels and Lubricating Oils for High Altitude Flight. E. L. Bass. *Petr. Times*, 19.12.36, **36**, 773.—The desirable characteristics of the fuel for high altitude flight are outlined. *Anti-knock Value.* Since optimum compression ratio and degree of supercharge are essential, very high anti-knock value is needed. Inlet mixture temperatures are excessively high, and, despite low air temperature, the mass cooling effect is lowered by the low density of the air at high altitude. Petroleum fuels with octane ratings of over 100 are available. *Vapour Pressure.* This may have to be as low as 3 lb. Reid at 100° F. for an altitude of 50,000 ft. and a fuel temperature of 15° C., unless the fuel is pre-cooled. *Calorific Value* must obviously be as high as possible for the sake of economy in weight. *Volatility.* This property may suffer a little in meeting the low vapour-pressure requirement, but suitable fractions are available to ensure adequate mean volatility (recoveries to 100° and 150° C.) for good distribution. *Freezing Point.* The maximum freezing point should be minus 80° C., to allow an adequate safety factor. Apart from the usual properties of the lubricating oil, extremely low volatility is required. At the low pressure obtaining at high altitude, oil coming in contact with the hot piston may be heated above its boiling point. Many of the fuel problems would be overcome by the adoption of bi-fuel and pressure fuel systems, the more volatile fuel being used only at high altitude. The problems

would be simplified too by the use of spark-ignition injection or compression-ignition engines. H. G.

355. Future Possibilities of 100 Octane Aircraft Engine Fuel. F. D. Klein. *J.S.A.E.*, 1936, **39**, 304–310.—The author stresses the importance of engine and fuel development progressing simultaneously if the maximum increases in engine performances are to be achieved. It is emphasized that the use of a high anti-knock fuel alone will not ensure high performance. A specific instance of this is quoted where the performance of the engine was limited by the high turbulence pistons employed and the high temperature of the air from the supercharger.

Comparisons are given of the performances obtained on a special high-output single cylinder unit. Particulars are given of a series of tests scheduled in an R-1820 (Cyclone) engine. Three series only of the six series planned are reported on, as the full programme was uncompleted at the time of publication. The first of these three series make comparisons between Army 92 and Army 100 octane at 10–1 blower ratio. Series 2 and 3 compare 100 octane toluene and *iso*-octane blends at blower ratios of 10 : 1 and 7·4 : 1. The article also deals with the available supply of *iso*-octane fuel which is estimated at approx. 1000 million gallons per annum, or more than fifteen times the present consumption of aircraft fuel in the U.S. The commercial development and future possibilities of this class of fuel are also discussed. C. H. S.

356. Motor-Fuel *Iso*paraffins by Thermal Gas Polymerization. F. E. Frey. *Oil & Gas J.*, 7.1.37, **35** (34), 40.—A discussion is presented of an experimental study of the non-catalytic union of ethylene with propane and *iso*butane to produce *iso*paraffins of high octane number.

The apparatus used consists of a 36-in. stainless steel reaction tube in a furnace maintained at about 500° C., in which the reacting gases are pumped at 4500 lb. per sq. in. In order to reduce olefin–olefin reactions, the olefin concentration is reduced, fresh olefin being introduced during the reaction to replace the converted olefin. The gases are withdrawn to a water cooler and to an expansion valve where the pressure is reduced to 100–150 lb./sq. in. and the gases are recycled. After complete reaction the products are examined by low-temperature fractional distillation and Orsat analysis.

The experimental data tabulated indicate that under the conditions of the experiments mixtures of 4·7% and 8·9% of ethylene with propane yielded 7·2% and 11·2% of gasoline, whilst a mixture of 12·1% of ethylene with *iso*butane gave 16·3% of gasoline. Thermodynamic calculations showed that higher yields of alkylation products would have been obtained by larger olefin additions and under lower pressure conditions. Half to three-quarters of the liquid products formed consisted of a mixture of isomeric paraffins the molecular weight of which was equal to the sum of the paraffin and olefin reactants.

The rate of thermal ethylation of the *iso*butane decreases in the order tertiary-secondary-primary, and very high pressures favour primary paraffin–olefin junctures, whilst lower pressures favour alkylation involving olefin polymers as well. Once-through conversion gives a higher yield of high-boiling compounds than circulation conversion, a yield of 20·4% of gasoline being obtained from a mixture of 16·5% ethylene in *iso*butane after single pass at 4700 lb./sq. in., whereas a mixture of 12·1% of ethylene in *iso*butane after re-circulation at 4500 lb./sq. in. gave a yield of 16·3% of gasoline. The high content of paraffins in the gasoline from once-through conversion indicates extensive alkylation, but not the primary alkylation of the circulation experiment.

The choice of suitable alkylation conditions and reacting materials renders possible the synthesis of *iso*paraffins of varying structure and molecular weight or volatility, and of high anti-knock value, stability, calorific value and lead susceptibility. A 2 : 2-dimethylbutane separated from the polymer gasoline gave an O.N. (A.S.T.M.) of 94·5 of higher volatility than *iso*-octane (boiling range 116–131° F.). C. L. G.

357. Synthetic Fuels. F. Fischer. *Petr. Zeit.*, 13.1.37, **33** (2); *Motorenbetrieb*, **10** (1), 5–7.—The production of synthetic fuels is described by the Bergius I.G. hydrogenation process and the Fischer process using water-gas as initial material. Both processes

yield benzine, diesel and lubricating oils. In the Fischer process, water-gas obtained by gasifying coal or coke is freed from dust and H_2S, the sulphur content being reduced to 0·2 gm./100 cbm. Organically bound sulphur is removed by passing the gases through a specially constructed catalyst oven at 200° and at atmospheric pressure. The catalyst consists of a mixture of Fe, Ni or Co metals which are not immune to poisoning. Total synthesis of CO and H_2 occurs, CH_2 radicles are formed which combine to produce in the contact oven, benzine and oil molecules.

The I.G. process utilizes coal-tar oils and a high-pressure apparatus. The temperature and pressure employed are 400° and 200 atm., and the process is a destructive hydrogenation process and is carried out in two stages using a molybdenum catalyst which is immune to poisoning.

Regarding the character of the products obtained from both processes, the I.G. produces cyclic compounds and the Fischer process yields aliphatic compounds, *e.g.* benzine, diesel and lubricating oils, paraffin wax and fatty acids. The annual output from the Fischer plant amounts to 30,000–40,000 tons per annum. It can, moreover, be installed quickly, as only sheet iron is required for its construction, on account of the lower temperatures and pressures employed.

The synthetic fuels obtained by the Fischer process are claimed to be comparable with Pennsylvanian fuels, and the relative quantities of products can be varied to a certain extent. Normally, 65% of benzine and 20% of diesel oil are obtained. The olefine constituents of the benzine can be converted into lubricating oil by means of the aluminium-chloride process. W. S. E. C.

358. Synthetic Decanes as High Anti-Knock Fuels. P. L. Cramer and J. M. Campbell. *Ind. Eng. Chem.*, 1937, **29** (2), 234.—The synthesis and physical properties of a number of diamylenes and the corresponding decanes, prepared by the reaction of sulphuric acid with certain amylenes and amyl alcohols, and the hydrogenation of the resulting diamylenes, are described. The decanes derived either from dimethylethylcarbinol, trimethylethylene, or *unsym.*-methylethylethylene have anti-knock values comparable to that of *iso*-octane (2 : 2 : 4-trimethylpentane). The catalyst employed for hydrogenating the diamylenes to decanes was platinum–platinum oxide, the solvent being glacial acetic acid. The actual structures of the decanes obtained from the above intermediates have not been determined, but there is considerable evidence to support the view that the principal decane produced is a tetramethylhexane. Both *iso*decane and *iso*-octane are very susceptible to the anti-knock effect of tetraethyl lead. H. E. T.

359. Patents on Motor Spirit. D. L. Yabroff and J. W. Givens. U.S.P. 2,066,925, 5.1.37. Removal of acidic reacting substances from hydrocarbon liquids by treatment with diethyl sulphonium hydroxide.

O. F. Simons and R. A. Jack. U.S.P. 2,068,126, 19.1.37. Refining of motor spirit using aqueous ethanol.

C. Ellis. U.S.P. 2,068,850, 26.1.37. Refining of gasoline using H_2SO_4 and treating the resultant acid-treated gasoline with a small amount of maleic anhydride.

H. G. Schneider. U.S.P. 2,062,377, 1.12.36. Removal of sulphur and gum-forming substances from naphtha by agitating it with boron fluoride gas and boron fluoride dissolved in 100% H_2SO_4.

R. B. Day. U.S.P. 2,063,082, 8.12.36. Removal of deleterious sulphur constituents from motor spirit by treating it in the liquid phase with HCl in the presence of zinc and copper chloride.

J. C. Morrell. U.S.P. 2,063,113, 8.12.36. Desulphurizing motor spirit in the vapour phase with hydrogen to convert the sulphur compounds into H_2S. The H_2, H_2S and those constituents heavier than gasoline are fractionated and separated. The gasoline fraction is then polymerized in the presence of a catalyst consisting of molybdic acid, nickel oxide and sodium aluminate.

R. B. Day. U.S.P. 2,063,491, 8.12.36. Cracked gasoline is refined by treating it at 200–600° F. with aqueous HCl in the presence of solid zinc or mercury chloride.

J. C. Morrell and G. Egloff. U.S.P. 2,063,517, 8.12.36. Process as described above using as refining agent HCl and an aqueous solution of cupric chloride in the presence of solid cuprous chloride.

J. C. Morrell and G. Egloff. U.S.P. 2,063,518, 8.12.36. Process as described above using aqueous HCl and an aqueous solution of zinc chloride in the presence of a solid zinc salt.

O. F. Simons and F. C. Croxton. U.S.P. 2,063,597, 8.12.36. Extraction of gasoline using a mixture of 20% of pyridine and 80% of liquid sulphur dioxide in the proportion of 75–500 vols./100 vols. of distillate extracted. The pyridine and sulphur dioxide are recovered from the extracted gasoline.

R. C. Osterstrom. U.S.P. 2,063,522, 8.12.36. Cracked motor spirit is decolorized and freed from gum-forming constituents by treatment with fuller's earth and introducing into the treated oil-polymers in regulated proportions in order to accelerate polymerization of certain compounds.

J. F. Wait. U.S.P. 2,063,861–2,063,862, 8.12.36. Cracked vapours are refined by treating them with molten alkali metal at 300–500° C.

V. Ipatieff. U.S.P. 2,063,933, 15.12.36. Method described for increasing the yield of gasoline in cracking operations. The mixture of gasoline and olefinic gases is treated with a mixture of solid calcined siliceous material and phosphoric acid under pressure to polymerize the gases. The polymerized gasoline is recovered in admixture with the cracked gasoline.

C. Banta. U.S.P. 2,064,455, 15.12.36. Refining of motor benzol using sulphuric acid.

P. C. Keith, Jr. U.S.P. 2,064,757, 15.12.36. Method of stabilizing and absorbing gasoline.

C. B. Watson. U.S.P. 2,064,999, 22.12.36. Desulphurizing of gasoline by mixing it with lime, heating to vaporize naphtha and H_2S, and then subjecting the vapours to counter-current fractionation with copper oxide suspended in heavy reflux oil.

H. Dimming. U.S.P. 2,066,100, 29.12.36. Process for debutanizing gasoline.

W. C. Marchant. U.S.P. 2,066,213, 29.12.36. Removal of sulphur from motor spirit by allowing the vapours of the hot spirit to come into contact with cuprous oxide briquetted with linseed oil. W. S. E. C.

Lubricants and Lubrication.

360. Handy Chart Determines Power Consumed in Bearings. W. F. Schaphorst. *Petr. Eng.*, Jan. 1937, **8** (4), 101.—A nomograph is reproduced from which the horse power consumed by any bearing can be determined, knowing the coefficient of friction, shaft diameter, revs. per minute, and the load on the bearing. It can also be used to determine the coefficient of friction, if the power absorption is known, and from these the power required for a similar bearing of different diameter, speed and loading can be determined. The chart indicates the advisability of low tension in belts, low shaft speeds, the use of small shafts and the maintenance of bearings well oiled, with the proper oil and in good condition. C. L. G.

361. Pour point of Lubricating Oils Reduced by Use of Dewaxing Assistant. Anon. *Oil & Gas J.*, 21.1.37, **35** (36), 41.—Experiments recently carried out at the Port Jerome refinery of the Standard Franco-Americaine de Raffinage have shown that the addition of Paraflow to bright stocks prior to centrifuging permits higher centrifuging rates, gives greater yields and the resulting oils possess less tendency to cloud at low temperatures. By addition of Paraflow, the formation of oil-free crystals during the chilling operation is facilitated, so that it should be possible to chill the solution

more rapidly and still obtain good separation on centrifuging, or else to achieve better separation under constant chilling conditions.

A Colombian cylinder oil prepared from a distillate of 210 viscosity Saybolt at 210° F. which had been phenol extracted, re-run over caustic and clay treated for colour, was used in the experiments. The properties of the stock were: A.P.I. grav. 24·3°, Visc. Saybolt 145 secs. at 210° F., V.I. 75 and pour point 45° F. The stock was dewaxed in trichlorethylene solution using six Separator Nobel centrifuges of the WX-7 type. Run No. 1 was made on straight stock dewaxing to 20° F. pour point; in Run No. 2 0·1% Paraflow was added and the oil dewaxed to the same pour point, and in Run No. 3 a similar addition of Paraflow was made, but dewaxing was carried to 10° F. pour point.

Operating conditions and properties of the output were :—

Run No.	1.	2.	3.
Paraflow % by wt.	0	0·1	0·1
Trichlorethylene in mixture, % by vol.	53·5	46·6	52·5
Temp. of dewaxing in °F.	−8	−5	−8
Hourly throughput per cycle day in brl.	19·75	25·16	22·67
Yield in % by vol.	94·5	96·0	95·2
Visc. Saybolt at 210° F. in output in secs.	150	144	147
V.I. of output	75	74	75
Pour Pt. of output in °F.	20	20	10
Cloud Pt. of output in °F.	25	25	0

When operating to the same pour point a 27% increase in throughput and a reduction of 25% in wax produced were thus obtained. It has also been found in the course of other experiments that oils dewaxed in the presence of Paraflow can be stored at 32° F. for longer than conventionally obtained products before any haze or cloud is noticed, although pour- and cloud-points may be similar. Longer runs are possible on account of reduced wax deposits in chilling, and in some cases it has been found possible to free the chiller coils of deposited wax by charging a waxy oil diluted with solvent to which has been added 0·1% of Paraflow. The results warrant further investigation with other oils, solvent combinations and types of wax separation.

R. A. E.

362. Treatment of Fuel and Lubricating Oil: Filtration and Renovation. A. Beale. *Diesel Eng. Users Assoc.* Read 9.12.36. Pub. No. S.134.—In the cleaning of the lubricating oil used in an engine, it is considered that the following advantages are obtained: (1) freedom from choked oil-ways and strainers; (2) freedom from excessive carbon deposits in the combustion chambers and sludge in the crankcase; (3) less wear of the engine parts; (4) lower gross lubricating oil consumption; (5) that filtration encourages the use of a high-quality oil and so reduces maintenance costs; (6) that filtered oil is better than new oil; (7) that the problem of the disposal of waste oil is eliminated.

Filtration of the whole of the oil as it flows to the working parts of the engine, although ideal, is not usually possible, on account of the high rates of flow and the limitation of using a filter of reasonable size. By-pass filtration provides the reasonable alternative in the case of the majority of present-day engines. A comparatively small rate of flow through an efficient filter will keep the whole of the oil in the engine system in good condition.

Batch filtration is not usually as efficient as by-pass filtration, but may be preferred in a power-house where there are a number of engines. It is suitable for the treatment of the oil from road transport engines where a suitable by-pass filter is difficult to instal and maintain.

The author does not consider that re-refining at a central depot has any advantages and considers that it would have the disadvantage of increased cost.

The mathematics of by-pass and batch filtration are developed, and the superiority of the former is demonstrated.

In dealing with the particular methods adopted for cleaning lubricating oil, the

author considers the following: (1) Pad filters. These are said to be efficient only when partly choked, in which case the rate of flow is low. It is considered questionable whether this type of filter can cope with internal combustion engine oil. (2) Settling systems, which are cumbersome, slow and wasteful of oil. (3) Centrifugal separation, which accelerates natural separation by increased gravitational forces. Owing to the fineness of some of the particles, the cleaning is not complete. (4) Chemical cleaning plants, which seek to make the settling tank practicable by precipitating impurities more quickly; there is still the wastage of oil and, in addition, the risk of contamination of the cleaned oil with the chemical. Chemical plants in conjunction with centrifugal separators have yielded some satisfaction. (5) Stream-line filters, which purify the oil by edge filtration between discs of fibrous material. This method gives perfect filtration, whilst the fact that all the impurities are held at the disc edges enables the filter to be cleaned and its output restored by periodical reversal with compressed air.

In regard to the filtration of fuel oil, the author considers that the advantages gained repay the extra cost. This is supported by practical evidence, and fuel oil cleaning systems are briefly described.

A summary of reports from engine users is given which demonstrates the advantages to be gained by cleaning oil. J. G. W.

363. Let the Physicist Change Your Oil. P. D. Foote. *J. of Applied Physics*, 1937, **8** (1), 19.—The applications and general properties of oils are discussed. The subjects considered are the Osborne Reynolds equation for film lubrication and Sommerfeld's application of it to the full bearing; the theoretical variation of film thickness and friction with pressure speed and bearing clearance; the variation of viscosity with temperature, with a brief reference to the suggestions of Lewis and Squires as to the reason for the improvement of viscosity index as a result of a small addition of high molecular weight material; and oxidation of mineral oils as a chain-reaction and the use of inhibitors to minimize the oxidation effects. The breakdown in the application of Sommerfeld's equation to bearings at low values of $\mu N/P$ (μ = viscosity, N = revs. per second, P = pressure on bearing per unit projected area) leads to a discussion of the possible sources of explanation—namely, increased viscosity of an oil when present in a thin film, and adsorbed layers in combination with surface irregularities of the bearing. P. D.

364. Compounded Diesel Engine Oil Reduces Wear on Piston Rings. Anon. *Oil & Gas J.*, 17.12.36, **35** (31), 46.—When diesel engines are operated under heavy loads, there is a marked tendency towards the formation of carbonaceous and sludge deposits on the piston and in the ring grooves. With conventional motor oils, this condition results eventually in stuck rings, loss of compression, loss of power, excessive fuel consumption, hard starting, and impairment of lubricating-oil distributing systems. Research work on the problem by the Standard Oil Company of California has resulted in the development of a specially compounded oil known as "R.P.M. Diesel engine lubricating oil." Most of the work has been carried out within the last three years on Caterpillar Diesel engines. Charts and photographs of pistons after use are presented to show results obtained with various oils, including the R.P.M. The problem of ring sticking in Diesel engines is closely related to ring belt temperatures on the piston, and these in turn are influenced by piston design, service conditions, load factors, cooling water temperatures and combustion characteristics. Furthermore, mineral oils exhibit widely varying tendencies in forming deposits on piston and in ring grooves. Depending on the type of oil and the refining method, deposits vary from hard lacquers to soft, spongy carbon, may form within narrow temperature ranges or over wide ranges; and vary in quantity. It is thus possible to design an engine to run satisfactorily on a given conventional oil, but not on all types. Compounding minimizes the effect of variation in ring-belt temperatures, permitting higher load factors and reducing maintenance expenses. Development work has so far been confined to motors equipped with conventional babbitt-type bearings. The oil cannot yet be said to be suitable for the new types of bearing metal. R. A. E.

365. Metallic Soaps for Thickening Mineral Oils. C. J. Bonner. *Ind. Eng. Chem.*, 1937, **29**, 58.—Eighteen metals were combined with double-pressed stearic acid and

with lard fatty acids. The soaps formed were heated with a naphthenic and paraffin base oil, with a Saybolt viscosity of 100 seconds at 100° F., under conditions such as are commonly employed in grease manufacture. With the exception of aluminium, only metals forming divalent compounds with the fatty acids were found suitable for the manufacture of greases. Soaps of the metals of the lowest atomic weights produced greases of the best transparency. Soaps of the more basic metals formed the softest greases. Water as an emulsifier was not required, except in the cases of strontium and calcium soaps. The consistency was heaviest and the dropping point highest in greases made from stearic acid. The behaviour of soaps in naphthenic and paraffin base oil was similar. J. W. H.

366. Vegetable "Sperm Oil." Anon. *Chem. Trade J.*, 11.12.36, **99**, 492.—The U.S. Bureau of Chemistry and Soils, Department of Agriculture, has discovered an oil of similar chemical composition to sperm oil in the seeds of a shrub (*Simmondsia Californica*), growing in lower California, Arizona and N. Mexico, called locally—wild hazelnut, sheep nut, goat nut or jojoba. The female plants bear nuts yielding 51·2% of a light yellow oil, actually a liquid wax which is not a glyceride, but is composed almost entirely of esters of high molecular weight, monoethylenic acids and alcohols. The jojoba oil is unusually stable, being only slightly discoloured after heating to 572° C. C. L. G.

367. Patents on Lubricating Oil. Alco Products Inc., D. B. Banks and P. D. Barton. E.P. 458,670, 18.12.36. Apparatus and method for the continuous dewaxing of hydrocarbon oils.

C. Ellis. U.S.P. 2,062,355, 1.12.36. Solvent extraction of lubricating oil using tertiary butyl alcohol.

W. D. Farr and F. B. Samuel. U.S.P. 2,062,356, 1.12.36. Separation of oil from slack wax.

G. J. Strezynski. U.S.P. 2,062,733, 1.12.36. Refining of lubricating oil with acid, removing the sludge and mixing the desludged oil with caustic soda solution and a minor proportion of triethanolamine.

S. W. Ferris. U.S.P. 2,062,872, 1.12.36. Solvent extraction of lubricating oil using ethyl chloracetate, chloracetone and dibrompropyl alcohol.

P. B. Renfrew. U.S.P. 2,062,933–4, 1.12.36. Refining insulating and lubricating oils by forcing the oil under 100 lb. pressure/sq. in. through a plurality of relatively minute orifices and subjecting the oil to a relatively high vacuum.

S. H. Diggs and J. M. Page, Jr. U.S.P. 2,063,369, 8.12.36. Solvent extraction of lubricating oils using dichlorethyl ether.

J. C. Stauffer. U.S.P. 2,063,564, 8.12.36. Separation of nitrogen bases from hydrocarbons by means of SO_2 or CO_2 or an aqueous solution of these substances.

R. E. Burk. U.S.P. 2,063,789, 8.12.36, and M. R. Fenske and W. B. McCluer. U.S.P. 2,064,422, 15.12.36. Apparatus for counter-current extraction of lubricating oil.

J. F. Wait. U.S.P. 2,063,860, 8.12.36. Refining of lubricating oil by mixing it with a small quantity of alkali metal and a clay-like substance and applying the mixture in film form to a previously heated surface. The temperature of the film is controlled at 350° C. and a vacuum is maintained on the film.

A. B. Brown and F. F. Diwoky. U.S.P. 2,064,338, 15.12.36. Solvent extraction of lubricating oil using an alkyl ester of a chlorinated aliphatic acid of low melting point.

C. C. Towne. U.S.P. 2,064,506, 15.12.36. Dewaxing of lubricating oil by means of a filter aid.

L. C. Beard, Jr. U.S.P. 2,065,551, 29.12.36. Lubricating oil is prepared from cracked gas oil by SO_2-treating the viscous distillate obtained after the removal of the tar at low temperatures.

V. G. Shinkle. U.S.P. 2,065,619, 29.12.36. An apparatus is described for purifying and fractionating used crank-case oil.

G. J. Strezynski. U.S.P. 2,066,164–2,066,166, 29.12.36. An apparatus is described for dewaxing oils.

W. A. Eberle and M. B. Hopkins. U.S.P. 2,066,200, 29.12.36. Decolorizing of lubricating oils by means of acid, removing the sludge, neutralizing the desludged oil with KOH and percolating the oil through a layer of coarse clay. W. S. E. C.

Asphalt and Bitumen.

368. Design of Sheet Asphalt. I. Bencowitz. *Ind. Eng. Chem.*, 1937, **29**, 98.—The brittleness of briquets composed of an aggregate bound with asphalt is determined by tumbling them in a revolving drum under standardized conditions. When the percentage loss after 1 hour is plotted against the asphalt content, it is found that the lowest safe percentage of asphalt is sharply defined. The upper limit of the asphalt content is measured by the time taken for a sphere to penetrate the briquet to a given depth, when a load is applied in accordance with certain specified conditions. The effect of the addition of various proportions of fillers to the aggregates is examined, and the results found to check closely with the facts empirically established by highway engineers. J. W. H.

369. Patents on Asphalt. A. R. Ebberts. U.S.P. 2,067,264, 12.1.37. Manufacture of bituminous substances by blowing residues obtained from a mixed base crude and from a naphthenic-base crude.

J. O. Collins. U.S.P. 2,068,845, 26.1.37. Manufacture of hard bituminous substances from cracked residues by vacuum distillation and then contacting the reduced residue with a gas containing free oxygen. The bituminous substance thus obtained (softening pt. 275° F.), is dissolved in benzol, insoluble substances separated and the solvent evaporated from the dissolved bituminous substances.

C. Mack. U.S.P. 2,062,366, 1.12.36. Preparation of asphalt of low susceptibility to temperature change by blending a minor proportion of blown residue (of softening point 380° F.) with another asphaltic residue of softening point 100° F.
W. S. E. C.

Special Products.

370. Solvents from E. Texas Oil. G. Weber. *Oil & Gas J.*, 17.12.36, **35** (31), 34.—A 10,000-brl. crude distillation unit capable of producing solvents and special naphthas as required has recently been completed by the Pure Oil Co. at Smiths Bluff, Texas. In addition to the special products, straight-run gasoline, kerosine, gas oil and fuel will be produced.

The distillation is carried out in two steps, and the furnace is equipped with separate sections for primary and secondary heating. Nearly all the heating surface in wall and roof tubes is located in radiant position with some convection heating in the second row of the roof tubes, past which flue gases leave the furnace. The two units are fired from both ends, flue gases passing through a common manifold from the top of the furnaces to the stack. The main fractionator measures 127 ft. in height and 10 ft. in diameter and is divided into two sections. The upper section receives the crude charge from the first furnace and the light ends are removed. The topped crude passes to the second furnace and is charged to the lower section. Although close-cut fractions can be obtained from the main tower, sharper cuts are obtained from the side strippers. Two of these units, one of which is divided into two sections, receive and strip the streams from the main tower, producing a very close-cut fraction. The

auxiliary columns are used primarily in the manufacture of solvents. The first distillation is carried out at relatively low temperatures (550° F. average in the charge to section), thus precluding danger of over-heating light fractions and ensuring sweet solvent cuts. The charge to the lower section of the fractionator averages 785° F. Operating in this way the following yields from E. Texas crude have been obtained :

Gas	1%
Absorption gasoline	2%
Rubber solvent	14%
V.M. & P. naphtha	8%
Stoddart solvent	10%
Kerosine	10%
Gas oil	33%
Fuel oil	22%

Van Zandt crude has also been processed, but is not so suitable for solvent manufacture. Extremely close control is held on the plant's operation by instruments regulating flow, temperature and pressure throughout the system, and one man is employed in its operation. R. A. E.

371. Chemicals in Dry Cleaning. Anon. *Chem. Trade J.*, 25.12.36, **99**, 543.—In a paper presented before the London Section of the Society of Dyers and Colourists, C. L. Bird discussed recent improvements in the technology of dry cleaning. Better cleaning is effected by the presence of water in the dry-cleaning bath, but the amount that can be incorporated in dry-cleaning soaps is limited. The Sanitone process (E.P. 392,931) is based on the introduction of water by the use of mahogany sulphonates (bye-products of petroleum refining) which are soluble in dry-cleaning solvents, giving solutions capable of dissolving water. The garments are cleaned with a 1% solution of sanitone in the dry-cleaning solvent, the dirt removed being filtered off. Water is then trickled into the solution, being first dissolved and then absorbed by the garments. The mahogany sulphonates have no affinity for textile fibres, but merely act as water-carriers. Dry-cleaning solvents which give satisfactory results include carbon tetrachloride (although liable to cause corrosion of iron, so that special alloys should be used), trichlorethylene (vapours less toxic than carbon tetrachloride, but has slight solvent action on certain cellulose acetate rayon dyes) and perchlorethylene (possesses the advantages of trichlorethylene without its solvent action on dyes).

Chlorinated hydrocarbons are stated to give better results than white spirits, particularly with dry-cleaning soaps of the correct type. In the case of trichlorethylene the formulation of a suitable soap is a matter of some difficulty.

C. L. G.

372. Manufacture of Petroleum Residues by Means of Selective Solvent Agents. A. Flachs. *Petr. Zeit.*, 13.1.37, **33** (2), 1–4.—This article describes the apparatus and method used for treating petroleum residues from Mazout to obtain lubricating oils by solvent extraction. The solvents used are ethyl ether and ethyl alcohol.

W. S. E. C.

373. Patents on Special Products. J. Y. Johnson. E.P. 459,189, 4.1.37. Recovery of aromatics from liquid hydrocarbons by extraction at a temperature of 20° below zero °C. by means of liquid SO_2.

I.G. Co. E.P. 459,270, 5.1.37. Stabilization of lead tetraethyl and anti-knock mixtures containing it by means of an alkali metal fluoride and a monohydric alcohol which has a solvent action on the lead tetraethyl.

Bat. Petr. Mij. and C. T. Kautter. E.P. 458,026, 23.12.36. Production of carbonyl compounds, *e.g. iso*butyraldehyde from *iso*butylene, by the action of a tertiary olefine in the liquid phase on chlorine and excess water at 140–250° C. The reaction is carried out in the presence of calcium carbonate.

C. A. Thomas and J. F. Alin. U.S.P. 2,065,323, 22.12.36. Production of unsaturated aliphatic hydrocarbons containing 12 or more carbon atoms by chlorinating the corresponding substituted paraffin hydrocarbons.

E. I. Du Pont de Nemours & Co. E.P. 458,475, 21.12.36. Manufacture of dialkyl ethylene glycols by reducing keto-alcohols at 20–25° C. and under 10–75 atm. pressure using amyl alcohol and an alkali metal amalgam. W. S. E. C.

Detonation and Engines.

374. Future of the Petrol Engine. H. L. Pomeroy. *Petr. Times*, 12.12.36, **36**, 741.—The advantages that the C.I. engine possesses over the petrol engine are due, almost entirely, to its higher thermal efficiency and the lower price of its fuel. The recent taxing of diesel fuel has limited the latter advantage already. The author suggests that the future tendency will be to lower the compression ratio of C.I. engines and to increase it for petrol engines, so that ultimately the two engines will be on a much more equal footing from the point of view of thermal efficiency. In other words, it is suggested that the economic inducement to use the C.I. engine will disappear. Problems of reliability, power output, and economical manufacturing costs are ones which will be solved for both types of engine. The author envisages that the future petrol engine will have a larger number of cylinders, in order to achieve a greater degree of reliability due to a better distribution of stresses and more smooth and quieter running, and a big extension in the use of superchargers. H. G.

375. Slow-Motion Shows Knocking and Non-Knocking Explosions. L. Withrow and G. M. Rassweiler. *J.S.A.E.*, 1936, **39**, 297–303 and 312.—In previous work on photography of explosions in an internal-combustion engine only small portions of the combustion space have been examined. The authors have now succeeded in constructing a special high-speed camera and a fused quartz cylinder head for a single-cylinder engine, which have made it possible to obtain pictures at very short intervals of the whole combustion space. Difficulties in obtaining a gas-tight seal between the quartz window and the cylinder have been successfully overcome, and the problem of a suitable carrier for the quartz sheet has been solved by making the frame of Invar and water cooling it.

Sets of photographs are given of knocking and non-knocking explosions, each consisting of 30 photographs taken between 29° before T.D.C. and 40·6° after T.D.C.

The propagation of the flame can be followed with remarkable clarity in these pictures, and the spontaneous ignition of a portion of the charge in the knocking explosion; also the presence of incandescent carbon from partly burned lubricating oil in the non-knocking explosion taken at a higher speed of 2000 r.p.m. are shown very distinctly.

Another series of pictures shows the occurrence of detonation in six separate explosions between 2·6° before T.D.C. and 9·4° after T.D.C. Six pictures are reproduced in each case. In this series it can be seen very clearly that auto-ignition varied as regards position in the cylinder. This is significant, as if knock were caused by a localized hot-spot or hot-spots on the combustion chamber walls, auto-ignition should always occur in the same position in consecutive explosions. C. H. S.

376. Visual Study in a Displacer-Piston Compression-Ignition Engine. A. M. Rothrock. *J.S.A.E.*, 1937, **40**, 22–27.—This article describes experiments carried out to observe the effect of a displacer piston on air flow and the effect of air flow on the fuel spray and flame formation. The apparatus used was the N.A.C.A. combustion apparatus which has been described in N.A.C.A. reports. It was also desired to photograph the air movement without disturbing the normal operation of the apparatus. This was done by the use of the " Schlieten " or " Striae " photography, which makes varying refractive index of a transparent medium visible.

The combustion head is fitted with two vertical windows of 2½ in. diameter. Light from a projection lamp is transmitted by suitable lens system through the chamber to a high-speed motion-picture camera operating at 2000 frames per second. Any local change in the refractive index of air in the combustion causes a deflection in the parallel rays, thus resulting in light or dark areas being formed on the motion-picture film. The image of the fuel spray silhouette and of the combustion was photographed in the normal manner.

Parts of the films taken are illustrated, but it is pointed out that air movements recorded are invisible unless the film is projected as a motion picture. Records were taken while using differently placed displacer plugs and with injection from different positions. The author concludes that: (1) air velocities of 300 ft. per second are not sufficient to destroy the core of a fuel spray from a round hole orifice; (2) such velocities are sufficient to change the direction of the spray penetration and to blow aside the spray envelope; (3) in employing air flow in a combustion chamber, care must be taken that the air motion set up during the induction is not such as to oppose the desired flow produced at the end of the compression stroke. C. H. S.

377. Cylinder Temperature. M. O. Teetor. *J.S.A.E.*, 1936, **39**, 328–332.—The evils of cylinder distortion have become more pronounced during the last few years, mainly due to higher speeds, and a large amount of the trouble regarding excessive oil consumption at such speeds can be traced to high cylinder temperature. The author points out the futility of honing cylinders to limits specified in ten-thousandths of an inch when under running conditions distortion completely defeats the object aimed at. Particulars are given of cylinder wall temperatures determined with special design of thermocouples.

It is shown in one case how the temperature at one side of a cylinder wall at 3500 r.p.m. reached 540° F., whilst at a point diametrically opposite the recorded temperature was only 290° F. The distortion of cylinders varies greatly with load, and curves are given showing temperatures at similar points in different cylinders of a multi-cylinder engine. The checking of surface temperatures in many engines shows a relation between such temperatures and scuffing. It has been shown that in general when the surface temperature exceeds 400° F. a breakdown in lubrication may be expected, with consequent metal to metal contact between ring and cylinder.

Particulars of temperature records in three single-cylinder water-cooled engines of varying design show how it was possible to bring down the full-load cylinder surface temperature at 4000 r.p.m. from 650° to 250° F. C. H. S.

378. "Combustion Factor" Diagram for C.I. Engines. W. G. Cowland and P. Henderson. *Engineer*, 12.2.37, **163** (4231), 183.—The authors describe a method of examining the performance of an airless injection engine without having recourse to the use of an indicator. The B.M.E.P. and fuel consumption are determined over the power range of the engine for the selected speed, and the product—B.M.E.P. lb./sq. in. × fuel lb./B.H.P./hr., called the combustion factor, plotted against B.M.E.P. It is found that a straight line can be drawn through a range of points about and below 40 lb./sq. in. B.M.E.P. above which the line curves slightly. Assuming that the mechanical losses for the given speed are constant—evidence that this is so is given by figures taken from actual indicator diagrams—and that the indicated thermal efficiency is constant over the range in which the line is straight, by producing the line until it intercepts the B.M.E.P. axis (*i.e.* where the combustion factor is zero), the mechanical losses in lb./sq. in. M.E.P. can be read off. If the origin is moved down the B.M.E.P. axis by the amount of the losses, the line then represents the engine performance with respect to M.E.P. Curves are reproduced showing a direct graphical comparison of the combustion performances of a range of six engines determined by these means, and an appendix shows the theoretical derivation of the combustion factor and its aid in calculating the thermal efficiency of an engine. E. F. C.

379. Report on Heavy Oil Engine Working Costs (1935–1936). Anon. *D.E.U.A.*, 1936, S.129.—The report deals chiefly with heavy-oil-engine operating costs returned by 56 electricity generating stations in various parts of the world. Fuel and lubricating oil costs, particulars of the engines used, together with observations made on liner wear, are first given, whilst a curve is reproduced from results submitted showing the relation between the annual station load factor, and renewals and replacements costs. Two comprehensive tables contain the complete returns made, one showing the heavy-oil-engine costs per unit generated of 56 stations for the year 1935–1936, and the other the average long-period costs per unit generated of 31 stations. In addition to the foregoing, the report also contains data supplied by the Canadian National and Royal

Hungarian State Railways in respect to diesel-engined rail-cars, whilst a final table shows the heavy-oil-engine costs returned by a number of waterworks. E. F. C.

380. Sapphire and Other New Combustion-Chamber Window Materials. G. Calingaert, S. D. Heron and R. Stair. *J.S.A.E.*, 1936, **39**, 448–450.—An account of an investigation of the properties of various materials for the construction of observation windows. Curves are given showing the light transmission characteristics of quartz, spinel, sapphire, periclase and fluorite. Transparency of these materials to the infra-red increases in the order named. The mechanical strength of the first and last of these is poor, whilst that of spinel and sapphire is good.

For small windows sapphire has great advantages. It should be possible, by appropriate choice of material, to study selectively the emission in various regions of the spectrum. C. H. S.

381. Fuel Pressure Waves. C. C. Keane. *Petr. Eng.*, Jan. 1937, **8** (4), 31.—This article consists of a discussion of fuel injection valves and how they affect the performance of modern high-speed diesel engines. Curves are given showing valve lift under varying conditions and out of phase pressure diagrams with corresponding valve lift diagram. L. V. W. C.

382. Cathode-Ray Oscillograph Applications. R. R. Batcher. *Instruments*, 1936, **9**, 12, 341.—A description of the analysis of wave forms obtained with a sinusoidal time-base. P. D.

383. Cathode-Ray Oscillograph Applications. R. R. Batcher. *Instruments*, 1937, **10**, 1, 19.—A description of the application of oscillographs in testing radio receivers, valves, filter circuits, etc. P. D.

384. The Application of Diesel Engines to Rail Traction. T. Hornbuckle. *Diesel Eng. Users Assoc.*, read 11.11.36, Pub. No. S.133.—The general basis of working on railways is discussed, and the author considers the following possible fields of application for diesel engines: (1) railways working under conditions unfavourable for steam operation; (2) rail cars; (3) train sets; (4) mobile power plants; (5) (*a*) locomotives for shunting; (*b*) power locomotives.

(1) In countries where steam operation was difficult and costly, due to lack of suitable water and fuel supplies, the introduction of diesel power might effect considerable economies. The form in which such power was introduced would probably not be the mere substitution of diesel locomotives of similar power to the steam locomotives displaced.

(2) High maintenance costs had often been an adverse feature of diesel rail cars, but the principal reason for their failure was the difficulty in displacing a locomotive. Some difficulties had been experienced with the operation of signalling mechanisms owing to the lower axle loads.

The author considers that the successful working of rail cars can be achieved only when they are designed for specific working conditions, and that they may be regarded as special purpose machines not suitable for general adoption.

(3) Train sets had a more general application than rail cars, and by special methods of construction, the weight per seat could be reduced considerably. Mention is made of successful continental and American train sets.

(4) Mobile power plants consisted of diesel-engined locomotives in which the larger proportion of the electrical power generated was used to drive motors mounted on the train. The use of this type of equipment by the Buenos Aires and Great Southern Railway is mentioned.

(5) The application of the diesel engine to locomotives is examined, and the requirements for successful operation are outlined. Some diesel-electric systems are briefly described.

The type of engine most suitable for rail traction and the form of transmission are outlined.

In summarizing, the author considers that it is difficult to predict the future of the

diesel engine for rail traction, since there were so many factors to take into account; it rested with the engineer to select the most suitable power for his particular set of circumstances. J. G. W.

Coal and Shale.

385. Production of Oil from Coal in Britain and other Countries. Anon. *Petr. Times*, 19.12.36, **36**, 778.—The whole problem is exhaustively reviewed, chiefly from the economic viewpoint. None of the three processes—viz., hydrogenation, low-temperature carbonization and synthesis from gas—is capable of producing petrol at a price comparable with that of the natural product. Even in Germany, where larger quantities of suitable coal are available, the process can be justified only as a national expedient. The whole undertaking is shown to be of questionable value to taxpayer, coal-owner, and coal-miner alike. Even as a means of extra safety in war-time, the wisdom of the venture is to be doubted owing to the extreme vulnerability of the plants to air attack. H. G.

386. A Contribution to the Study of South African Oil Shales. A. J. Petrick. *Chem. Met. & Min. Soc. S. Africa*, December 1936, **37** (6), 209–288.—The introduction to this paper is a Survey of the Literature on the Nature of Oil Shale and Torbanite, on its Origin, on the Oil Shale Industry in Other Countries, and finally on various places in S. Africa where oil shales or torbanite were observed; accompanied by maps and tables of analyses, ending with an index of classified literature, arranged chronologically from 1910 to 1936, and numbering 168 publications.

The rest of the paper in six parts deals with :—

1. Carbonization assays of oil shales.
2. Hydrogenation tests on oil shale and coal samples.
3. Carbonization tests on a special sample of oil shale.
4. A study of the oils produced in the tests under Part 3.
5. Hydrogenation tests on higher-boiling fractions of shale oil.
6. General discussion and conclusions.

This is accompanied by 22 figures and 36 tables, including maps and charts.

The conclusions are :—

1. The Mooifontein oil shale or torbanite varied in yield of oil on carbonization, the shale from the central area giving higher yields than either the northern or southern area. Oil from shales in various localities was consistent in quality.

2. A higher yield by hydrogenating the shale was not sufficiently large to make the process attractive.

3. No very marked differences in yield of products was observed from testing the special sample of shale under varying rates of carbonization. It seemed that the yield of oil increased, but the quality of the crude oil decreased with increasing rates of carbonization. Carbonization of shale under increased pressure yielded oils that were low boiling, but at the same time cracking occurred; consequently the yield of oil was very much decreased. The process was not attractive.

4. At atmospheric and at high pressures, steam added during the carbonization increased the yield of oil. The oils produced under these conditions contained a higher proportion of high-boiling oils than those from dry distillation tests.

5. Analysis of crude oils produced at various rates of heating (atmospheric pressure) proved that these oils exhibited only small differences in composition.

6. Crude oils became less stable in concentrated sulphuric acid on being repeatedly distilled to dryness. Density and paraffin wax content increased, but the iodine number showed an increase after an initial decrease.

7. The crude oils contained about 20% of low-boiling distillates. This light fraction distilled with ease, but with rather high losses. The refined oils had lower densities, and contained smaller quantities of unsaturated compounds with iodine number still high. They were quite stable.

8. Hydrogenation experiments on the higher fraction of the shale oil showed that at 400° scarcely any low-boiling oils were formed, but the crude oil greatly

improved in quality. At 450° from 18 to 41% of petrol could be produced, depending on the time of reaction and the catalysts employed. Some pressure distillation tests on the heavy oil were less satisfactory. The gas yield was excessive, and only about 25% of petrol could be produced.

Finally, a comparison of the shale oil from Ermelo with that produced from shales in America and Europe leads to the conclusion that the Ermelo oil is superior in quality to a number of other shale oils produced on a commercial scale. It appears to contain very small amounts of asphaltic material and should yield valuable petrols, gas oils and lubricating oils. The oil fractions are predominantly aliphatic, although some fractions contain substantial quantities of aromatic compounds.

The paper lays claim to be only an opening chapter of the study of S. African oil shales, and the author hopes it may be instrumental in paving the way to such research. The paper closes with a second Literature Index of 24 references. B. F. N. M.

387. Progress of S. African Torbanite Mining and Refining. Anon. *Petr. Times*, 5.12.36, **36**, 716.—Operations at the S. African Torbanite and Refining Co.'s refinery commenced in January 1936. The retorts at Ermelo were fired intermittently from November 1936 and fairly continuously since June 1936. Pending the receipt of proper supplies of torbanite oil the charging stock at the refinery has been supplemented by imported crude oil. Approximately 290,000 gallons of torbanite crude oil have been produced up to date. A recalculation of the payable torbanite on the areas held by the company indicates that, in blocks having an oil content equivalent to 600 in.-gallons and over, there are 4,097,000 tons of torbanite of average width 18·4 in. and average oil content 46·5 gallons per ton. Under present conditions, 600 in.-gallons is considered to be the pay limit. Approximately 14,000 tons of torbanite and 19,000 tons of overlying coal have been mined so far. H. G.

Economics and Statistics.

388. New Discoveries Improve California Reserve Outlook. B. Mills. *Oil Weekly*, 8.2.1937, **84** (9), 21–24.—For seven years from 1929 to June 1, 1936, no major oilfield was discovered in California, but successful geophysical work has, since then, disclosed three important oilfields, and though it is early yet to put a close estimation of value on them, their total of reserves will amount to a substantial figure. During the depression years drilling was confined to development in producing fields, and geophysics as a rule was a failure in the State for several years, so much so that the major companies were seriously contemplating the abandonment of geophysics, in particular the reflection seismograph after six years of disappointing results. About two years ago it was discovered that there was nothing wrong with the reflection seismograph, the past failures being due to careless application and a poor interpretation of data. Results were improved immediately after a change was made in shooting methods, by drawing closer the straight parallel lines and by reducing the distance between shots. This alteration in method soon led to the belief that many of the old straight contour lines would have shown structural tendencies under a closer shooting plan. Geophysical prospects are much brighter, and the reflection seismograph bids fair to take the leading part in exploratory work. In the flat areas there has been a want of good reflecting strata, but the very deep formations have recently given satisfactory markers.

The discoveries of the Ten Section Oilfield and the Greeley field within 6½ miles distance from each other, have shown the way into the great flat area of the San Joaquin Valley, which, due to lack of geological surface exposures, would have been impossible to wildcat except at enormous expense of deep drilling and at long odds against hitting a good structure. With the aid of the reflection seismograph the Ten Section field was indicated and mapped after exhaustive geophysical exploration. The first well gave a big production of 61 gravity oil, and a second well when completed produced a lower gravity oil from the lower part of the sands. This second well was higher on the structure.

The Los Angeles basin after a five years decline is showing signs of a recovery, thus adding to the brighter prospects of California for 1937. B. F. N. M.

389. Brazilian Market Upset by Tariffs. Anon. *World Petroleum*, January 1937, **8** (1), 25.—Increase in small local refineries is creating a disturbing condition in the Brazilian petroleum products market. Brazil, having no domestic crude oil production and there being no necessity for such plants to supply the country's market, the local refineries are somewhat redundant, since the large international companies plentifully cater for the requirements of the country. The import duties on crude oil and diesel oil entering Brazil are about $\frac{1}{2}$ of a cent (U.S.A.) and $\frac{3}{4}$ of a cent/gallon, respectively, whereas the import tariffs on kerosene is about 5 cents/gallon and on motor fuel about 8 cents per gallon. It has therefore been profitable to import diesel oil and convert it into kerosene, and this has developed a demand for crude oil for use in a refinery capable of producing a full line of products. Figures are given showing an increase in kerosene sales of about 20% and in gasoline sales of about 176% for the first nine months of 1936 over the whole of 1935. Brazilian crude oil imports first became of importance in 1935, some coming from Argentina. The United States appear likely to be heavy losers as their refined products market in Brazil declines, because the U.S. purchases more Brazilian products than Brazil buys from the U.S., and its imports greatly exceed its exports to Brazil. The Brazilian Government will also probably lose in revenue from a decline in amount coming in from the relatively high tariffs on imported finished products which cannot be balanced by increased revenue from the very low tariffs on crude and diesel oils. The Brazilian Constitution provides that import duties shall not be increased by more than 20% per year, which prevents any immediate levelling up the huge disparity in the tariffs. B. F. N. M.

390. Oil and its Products. Rumania. Anon. *Rev. Comb. Liq.*, January 1937, **15** (141), 23.—The first eleven months of 1936 have shown a production of crude oil amounting to 8,000,173 tonnes, as compared with 7,645,916 tonnes for the same period in 1935. This appreciable increase is a matter of great satisfaction to the Rumanian industry, especially as this increase has been made with only a relatively slight increase in wells drilled. The Bucsani region, by intensive exploitation, was responsible for this good result. It now supplies nearly a quarter of Rumania's total production. As a set-off the other oilfields of the Dambovitza district have decreased in production; however, the production of the whole district has increased, representing 57·5% of the Rumanian production for 11 months of last year against 54% during the same period of 1935. The daily production fluctuates around 22,500 tonnes or about 157,000 brl., about the production of the State of Kansas, U.S.A. The Redeventza Company's well in the Margenini region, and also a later well of the Astra Romana, both flowing wells, are producing a crude white oil of extraordinary good quality very rich in motor spirit and other light hydrocarbons.

There is great activity in preliminary preparations to comply with concession conditions throughout the regions where exclusive exploration licences have been granted. These concessions cover very great stretches of country, and the activities are welcomed, as Rumania badly wants export oil.

The execution of the contract transferring royalties in kind to the "Petrofina" follows a normal course. By this contract, crude oil and motor spirits are exported to France. The amount in returns which results from them goes to the payment of the country's engagements. The Rumanian Ministry of Commerce has suffered a loss by the adjustment of the French franc which is partly compensated by the debt representing the material furnished having been incurred in Poincaré francs, so this debt can be settled by a smaller quantity of products, covering an equal number of Blum francs. B. F. N. M.

391. Distribution of Gasoline as a Public Utility. J. A. Celiz. *Bol. Inform. Petroleras* (B.A.), November 1936, **13** (147), 3, 4.—This is an introduction to, and immediately precedes the publication of, the regulation for the sale of gasoline in the Argentine capital, which was sanctioned by Ordinance No. 7750, consisting of eight articles. This ordinance, besides declaring that the distribution and sale of motor spirit in the territory of the Federal Capital shall be a public municipal service, gives the exclusive concession of this service to the Y.P.F., and lays down conditions of price fixing, inspection, etc.

The writer of the Introduction stresses the importance of the ordinance as assuring

the maintenance of the fiscal enterprise (the Y.P.F.), whose activities have been directed as their main object to the public good, in contrast to private enterprise whose final goal is essentially early private profits. It is claimed that this legal regime is in accordance with the political economy followed by the majority of modern legislatures of the countries whose subsoil contains this fundamental resource. B. F. N. M.

392. Petroleum as a Factor in National Defence. Anon. *World Petr.*, Dec. 1936, **7** (12), 616, 617.—This article is a review of the military preparedness of France with regard to motor fuel supplies and lubricants in the event of war. France's annual consumption of motor fuel is at present about 3 million tons. There are to-day in operation two hydrogenation plants with an estimated capacity of 10,000 metric tons per annum of liquid fuel. A third has been planned with an annual output of 25,000 tons, and a proposal made to the Chamber of Deputies early in 1936 was for a hydrogenation process to produce 300,000 tons of motor fuel per annum. It is pointed out that if all these plants were in operation at full capacity, they could only supply about 11% of the present annual requirements, and that hydrogenation costs under the best-developed conditions at present are from two to five times as great as that of refining crude oil.

France may be tempted to emulate Germany's example in attempting to develop resources of synthetic fuel, but, contrasting the situation of the two countries with regard to accessibility to outside supplies, Germany has only a narrow outlet to the ocean highways through the Baltic and North Seas, and her total sea frontiers are only about one-fifth of her total land frontiers, whereas France's sea frontiers are about equal in extent to her land frontiers, are on three sides, and one of them is wide open to the Atlantic Ocean In the absence of indigenous crude petroleum resources to meet her requirements, it is vital to Germany to develop her need of liquid fuel by synthetic methods, at even extreme cost, from the coal, lignite and waste gases of which she has an abundant supply. France has no such abundance of these raw materials; thus she must depend, not only for petroleum products, but also for many other extraneous necessities, on keeping open the sea ways. Military experts believe that France should import finished products rather than crude oil, because the cargoes would be less bulky, and could be landed at less obvious ports than those where refineries or storage tanks existed. Therefore it is necessary to maintain the good relations now existing with those possessors of the materials who can and will supply them. B. F. N. M.

393. Provision of Oil in Time of War. E. Leupold. *Bol. Inform. Petroleras* (B.A.), November 1936, **13** (147), 73–97.—This long article was provoked by the Argentine Press seeming to be imbued with the obsession that the Argentine Republic is mainly an oil-importing country, because its national production has not yet succeeded in covering its domestic commercial requirements in peace times, whereas in the case of a war the situation would be greatly aggravated by enormously increased consumption. Since 1930 there has been a markedly uniform decline in the Argentine importation of all oil sub-products, leaving out of the question the artificial increase of crude and diesel oil imports in 1934–1935, running into 1936, because they were not really necessary to the country's consumption. The excess of imports beginning in April 1934 only answered to the immediate commercial requirements of private, mainly foreign, enterprises, which operate in the Argentine. The 140% increase in one year, 1934–1935, unjustified to that extreme by Argentine industrial growth, was effected with the object of sustaining certain international partnerships in intensified price wars, and to undermine the financial potentiality of the national enterprise exploiting basic Argentine resources.

National production has been slowly but constantly increasing, and at length great promising-looking formations have been surveyed. By increasing the national production, the distribution of its distillates will be generally effected. By regulating adequately the unrestrained liberty of the world's trusts (as all civilized nations of the world have done), the Argentine will become entirely independent of foreign oil imports.

England, France, Germany, Italy and Japan, who have the most efficient and highly motorized armies of the world, do not produce conjointly a third of the Argentine production, and have stretched to the utmost the motorization of their armed institutions, by mechanizing their fighting and mobile elements. After giving in detail the

ways in which oil is essential for war, the article points out that oil has also a tremendous financial power in times of peace and of war, quoting various views on this aspect, and then puts the U.S.A. and Russia as the two most powerful nations, in view of their resources in men, agricultural and mineral resources, besides being the least vulnerable to aerial attack. Then follow in order of importance the United Kingdom, Japan, Germany, France, Poland and Italy. The countries which form the civilized world divide into two great groups: rich powers, as the U.S.A., Russia, France and the United Kingdom, and nations with deficient resources, as Germany, Japan, and Italy, a situation which plants the seed to grow into new destructive wars. A table and a chart of U.S.A. oil exports for six years are shown and then statistical tables of daily distilling and consumption capacity of 41 countries for the year 1935 are given, and the strength of the various nations in tankers is shown. Then the vulnerability of Great Britain is discussed, especially as to its overseas supply of oil and the chances of its reaching English ports. Various speeches and authorities are quoted, the storage question and its suggested protection is quoted and speeches from debates in the English House of Commons are the closing of this part of the article.

Finally the author concludes that in a matter of such intense interest to the Argentine it has been shown that the situation, with regard to provision of petroleum in time of war, of the Argentine Republic is truly enviable compared with the majority of the great nations of the world. It has good oil deposits and ample reserves in different zones of the country, with independent and rapid communication ways, and the numerous fiscal and private distilleries have a capacity adequate to the treatment, and will shortly be increased to respond to a greater national production. The National Government during a decade, through the intervention of the Y.P.F., a Department of the State, has raised oil from the most distant districts of the vast territory, with the object of fuel and with care for the future development of the country, while yielding to an unprepared Army one of its most efficient means of combat. Provision for the Army, Navy and Air Forces is therefore assured, and, if after experiments deduced from the manœuvres recently performed there are no difficulties to the application of motorized units in the Army, it is not appropriate for the Press to persist in a destructive campaign tending to provoke public discontent, because faith in the means which are arranged for national defence and in the power of the armed institutions which guarantee it, is, finally, half the victory. B. F. N. M.

BOOK REVIEWS AND BOOKS RECEIVED.

Book Reviews.

GULF COAST OILFIELDS: A SYMPOSIUM OF THE GULF COAST CENOZOIC. Edited by D. C. Barton and G. Sawtelle. American Association of Petroleum Geologists, Tulsa, Oklahoma; Thomas Murby & Co., London. xxii + 1070 pp., 292 figs., 19 half-tone plates. $4.00 (to Members and Associates $3.00).

THIS book is mainly a selection of papers reprinted from the *Bulletin of the Amer. Assoc. Petr. Geol.*, published in 1929, 1931, 1933, 1934, 1935 and 1936, with a Foreword by D. C. Barton. The object of this volume is to supplement the Symposium "Geology of Salt Dome Oilfields," a similar collection of papers printed in the *Bulletin* during 1925 and 1926 and issued in volume form in 1926. The earlier book was intended to comprise an account of American salt domes, of the oilfields on them, the theory of their origin, and to record part of the vast amount of data accumulated in 25 years of exploration around them. The present book endeavours to present a partial history of the great advance in knowledge during the last decade. A selection from the papers at the 1933 Convention of the Association forms the body-work of this volume, and a few important earlier papers have been added, whilst many additional papers have been solicited.

The composition starts with the Foreword by D. C. Barton, followed by an explanatory article on the interpretation and reading of an aerial photomosaic of the Barber's Hill salt dome mound and its environment, which is the frontispiece of the book. The collection of papers follows, divided into three main headings:—1. General and Theoretical papers; 2. Stratigraphy; 3. Description of Oilfields and Salt Domes. The Editors are the authors or co-authors of seven of these papers. D. C. Barton, in addition to the Foreword and the frontispiece article, contributes six, the last being on the Cote Blanche Salt Dome published in February 1936. G. Sawtelle is the author of "Salt Dome Statistics," published in a tabulated form bringing up to date of January 1936 the important statistics on discovery, geology and production of the Gulf Coast salt domes. "Geology of Salt Dome Oilfields" ends the history of 25 years oil exploration at a time when geologists, having gradually forced their way into the front of prospecting technique, were confronted with the difficult problem of indicating where new salt domes could be discovered within a vast area, which was lacking any of the significant superficial signs which led to the discovery of the earlier domes and oilfields. Up to 1924 geophysical methods and instruments, having failed to produce any convincing results, were classified as scientific "doodlebugs." From 1924 for 10 years onwards the improvement in geological knowledge and accuracy, due to continuous progress in interpretation of geophysical data, to improvement in its technique, to the development of proper coring and of intensive study of cores and to other methods of getting an accurate geological sequence from a drilled well, has been an astounding phenomenon. In the Foreword it is emphasized that the last decade, with which this volume deals, has far excelled all the progress made in the previous 25 years. Extraordinary advances have been made in drilling technique and equipment, in engineering and methods of production. Crude oil production in 1934 was triple that of 1924.

The editors have succeeded in embracing in one volume the most instructive papers selected from several volumes of the *Bulletins* and in furnishing it with a comprehensive index. The book should constitute a very useful addition to the library of those petroleum geologists who are interested in the morphology of salt domes, and also to students of oilfield geology.

In the theoretical papers it appears that the authors are inclined to assume that the theory or theories adopted by them have been definitely proved because they have been accepted rather generally by salt dome geologists, although there are others who cannot accept such theories so long as there is no evidence to disprove that other theories might be acceptable either in conjunction with the accepted theory or in contradiction of it.

The volume is very well and profusely illustrated by figures, plates, diagrams and tables, nearly every paper having at least one and some several accompanying the text.

B. F. N. M.

STRUCTURAL EVOLUTION OF SOUTHERN CALIFORNIA. R. D. Reid and J. S. Hollister. American Association of Petroleum Technologists, Tulsa, Oklahoma; Thomas Murby & Co., London. 157 pp., 8 half-tone plates, 57 line drawings, 6 tables, 1 folded map in colours. $2.00.

This book is concerned more with the history of the geological structure of Southern California than with its mechanical cause. In 1851, when the first section from San Francisco to the Mother Lode was published, the structure of the Coast Ranges was of great interest. In 1880 the U.S. Geological Survey began work in California, at first on ore deposits, later on oil prospects; in both studies structural problems were involved. Other workers studied structural problems and mapped Central California, but Southern California only received an important share of the work devoted to oil prospects. Since 1920 oil geologists have made detailed maps of nearly the whole of S. California, but have published spasmodically only a portion of their work. Thus a structural interpretation of this area must owe its basis largely to the effects of the oil hunters, and the value and completeness of their data in different provinces will depend on how great an attraction from a prospective oil view-point each province held for them. Consequently Tertiary areas generally were very fully mapped, Cretaceous less so and Pre-Cretaceous areas were almost entirely neglected. The authors, in appropriating certain views as their own, avoid claiming them as original. All of them are to be considered as the authors' only because they believe them to be more reasonable than any alternatives which have occurred to them. The tectonic map is a compilation, not an original work. Where no published maps exist, the authors have received valuable help from many friends, and an oil company and petroleum officials have permitted them to make investigations.

There are 10 chapters, 8 devoted to detailed reviews on: 1. The Diastrophic History; 2. Northern Geosynclinal Basin and Coaling a District; 3. Mohavia; 4. The Caliente Mountain District and Salinia; 5. The San Rafael and Santa Ynez Mountains; 6. Ventura Basin; 7. Anacapia; 8. Southern Geosynclinal Basin and the Los Angeles Basin. The first and last chapters are Introduction and Summary and Conclusions. In the last chapter the authors anticipate that structural geologists will ask such questions as, "What is the nature of the forces that from time to time have deformed the crust of coastal California and what their origin?" "Were the mountains warped up, thrust up or elevated in some other way?" and they reply to all such questions that they do not know, that, in spite of all their study, they do not yet know definitely what structural events happened from time to time and place to place in the Californian province, and that they confess to doubt as to the advisability of creating mechanical hypotheses until the succession of events to be explained has been well worked out. Mechanics in structural geology is of obvious importance, but, for a preliminary study such as this book, its chief use, according to the authors, is to furnish a basis for the criteria needed for deducing the time succession of tectonic events. Orogenesis and Epeirogenesis with Stille's two transition movements—synepeirogenic and synorogenic—are defined in accordance with the authors' interpretation of them. The area discussed is too small to throw much light upon problems concerning world movements, but has given results which may be interesting to those studying such large problems. The work embodied in this book can only be preliminary to the application of further investigation into such problems as whether orogenesis is world-wide in simultaneously affecting all mobile belts throughout the world, or the course of structural evolution has actually varied greatly from place to place. A definite and final conclusion on such problems is unlikely until comparison of many distant areas can be undertaken to correlate geological time periods of orogenic movements. This investigation is scarcely practical for one man, and could only be accomplished by the pooling of the individual work of several geologists in various parts of the world at a conference.

Transgressions also need most careful study, and in this connection the history of vulcanism may furnish a similarity in succession of events in widely distant sections of the world. Faulting, particularly the origin of thrust faults, has been carefully

studied, and the authors' theories are put forward. Finally, the claim is that this book is only an effort to assemble some of the materials out of which theories about Coast Range structure can be built. The theories herein put forward are merely samples to which readers can add, or for which they can probably substitute, their own better theories.

While this book may appear to be outside the particular interest of petroleum geologists, some of the theories advanced will be likely to be helpful to those who are seeking definite conclusions on the origin and on the time migration of petroleum.

The volume is very fully and excellently illustrated by maps, plates, drawings and tables. B. F. N. M.

Books Received.

BULL. 871. MINERAL RESOURCES OF THE REGION AROUND BOULDER DAM. D. F. Hewett, Eugene Callaghan, B. N. Moore, T. B. Nolan, W. W. Rubey and W. T. Shaller. Pp. vi + 197. 1936, Superintendent of Documents, Washington, D.C. 45 cents.

PROFESSIONAL PAPER, 182. THE TERTIARY FLORAS OF ALASKA. Arthur Hollick; with a chapter on the Geology of the Tertiary Deposits, Philip S. Smith. Pp. iii + 185. 1936, Superintendent of Documents, Washington, D.C. $1.00.

COPPER IN CHEMICAL PLANT. C.D.A. Publication, No. 23. 1936. Copper Development Association. Pp. 69. Copper Development Association, Thames House, Millbank, London, S.W. 1.

CONTRIBUIÇÕES PARA A GEOLOGIA DO PETROLES NO RECONCAVO (BAHIA), BRAZIL. S. Fróes Abreu, Glycon De Paiva, Iruack Do Amaral. Pp. viii + 216. Rio de Janeiro, 1936. (In Portuguese.)

Deals with the possibility of obtaining petroleum from the Cretaceous rocks of this region. A section indicates that no more than 150 metres in thickness of the Cretaceous beds in the area examined overlie the basal gneisses.

ASSOCIATION OF BRITISH CHEMICAL MANUFACTURERS: BRITISH CHEMICALS AND THEIR MANUFACTURERS. Pp. 466. 8vo. 1937, A.B.C.M., London.

The 1937 edition of the Biennial Directory of British Chemical Manufacturers brings up to date detailed information on the various chemicals produced in Great Britain. Being printed in English, French, Spanish, Italian, Portuguese and German, side by side, it should be of great value to purchasers throughout the whole world. The book is published gratis, to be obtained only by genuine purchasers of chemicals, not by intermediaries or booksellers, and will be supplied on application to the Association at 166 Piccadilly, London, W. 1.

JUNIOR INSTITUTION OF ENGINEERS. JOURNAL AND RECORD OF TRANSACTIONS. Vol. XLVI. 1935–36. 550 pp.

Included in the papers read before the Institution are "Some Aspects of Cement Testing," by R. P. Mears, and "Wire Ropes," by Walter A. Scoble.

INSTITUTION OF MECHANICAL ENGINEERS: PROCEEDINGS. Vols. 132, 133. January–March, April–November, 1936. Pp. xi + 612 and xii + 578.

Included in the papers published in Volume 132 are a symposium of papers on Fuel Injection Equipment, pp. 397–429, and a symposium of papers on Methods of Testing Internal Combustion Engines and Comparative Fuel Economy of Engines on Test and in Service, pp. 430–466.

Included in the papers published in Volume 133 are a paper on Plant for the Production of Petrol by the Hydrogenation of Bituminous Coal, by F. E. Smith, pp. 139–167, and a paper on Investigations in Film Lubrication by A. S. T. Thomson, pp. 413–472.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE: REPORT OF ANNUAL MEETING, 1936. Pp. xlii + 487. 8vo. 1936. British Association, Burlington House, London.

The 1936 Annual Meeting of the British Association was held in Blackpool, September 9–16, 1936, and the Report, preceded by a Five Years Retrospect (1931–1935) issued in April 1936, contains the addresses delivered by the President and by the various Section Presidents. Summaries of the papers presented to the various sections follow the Presidential address in each section. An Appendix of 152 pages contains a scientific survey of Blackpool and district, and a concise index of 19 pages closes the book.

U.S. Geological Survey:

BULL. 868 C. UPPER COPPER AND TANANA RIVERS, ALASKA. F. H. Moffit. Pp. 9. 1934. Superintendent of Documents, Washington, D.C. 10 cents.

IMPERIAL INSTITUTE. ANNUAL REPORT, 1936 and 4 Appendices. Pp. 61. By the Director, Sir Harry Lindsay, K.C.I.E., C.B.E.

This Report gives the Trustees and Board of Governors, Advisory Councils and Staff and contains four chapters, two on the work of the Scientific Department on Plant and Animal Products, and on Mineral Resources, one on the Exhibition Galleries and one on the Empire Film Library and Cinema Halls.

CANADA DEPT. OF MINES:

BULL. 763. INVESTIGATIONS IN ORE DRESSING AND METALLURGY. Pp. v + 237. 1936. King's Printer, Ottawa.

TRANSACTIONS OF THE GEOLOGICAL OIL INSTITUTE, U.S.S.R. (in Russian).

BULLETIN No. 16, 1932. Geological Exploration in the Black Mountains. A. A. Grechishkin.

„ No. 43, 1934. Foraminifera of the Upper Jurassic and Cretaceous Beds, Djaiksy-Bai Oilfield. L. G. Dain.

„ No. 51, 1935. Seven papers—6 on Palæontology in various parts of the U.S.S.R. and one on the Tertiary Deposits of East Sakhalin.

„ No. 52, 1935. Large Submarine Landslips in the Oligocene period of the North Caucasus. N. B. Vassoevich and S. T. Korotkov.

„ No. 54, 1935. Geological Structure of Tertiaries in South Abkhasia. S. I. Ilyine and A. G. Ebersin. On the Age of the Conglomerates of the Pitzunda Capes. A. G. Ebersin.

„ No. 62, 1935. Geological Map of the Kabristan. B. V. Weber.

„ No. 71, 1935. Geological Investigations in the Region of Kesslerovo Varenikovsky.

„ No. 78, 1935. Geological Investigations in Bolshye and Malye Shiraki in 1930–1931. Z. L. Maymin.

„ No. 67, 1936. From Vandam to Nukha. B. V. Weber.

All the above have a summary in English. No. 54 has also a summary in German of the second paper.

BULLETIN No. 44, 1935. The Fauna of the Shell Beds of the Dubrowaja Mountains. E. Liwerowskaja.

„ No. 62, 1936. The Ostracoda of the Aktschaghyl beds of the N. Caucasus and of the Taman Beds of the Kertsch-Haibinsel. A. V. Schweyer.

„ No. 73, 1936. On the Storage Relationships of the Petroleums in the Fergana Territory. K. T. Kalicki.

These three have each a German summary.

Bulletin	No. 31, 1934.	Geological Investigations in Daghestan. M. N. Saidov and N. M. Markin.
„	No. 34, 1934.	Geological Investigations in Daghestan. N. N. Rostovzev and N. A. Bilalov.
„	No. 46, 1934.	Three papers—Geological Investigations in the Shurabad, Jaccabag and Houzard and in the New-Bouckara Regions. N. Touaiev, N. Schvemberger and G. Shatov.
„	No. 53, 1934.	Three papers—Djakssy-bai, Dongelek-sor, and Imankara Oilfields (Emba Region). N. I. Boojalov and N. A. Hramov.
„	No. 51, 1935.	Oil-bearing Capacity of the Taimirsky-Lensky District. Smirnov and Ourvantzer.
„	No. 64, 1935.	Chiklishar Region Gas Volcanoes, 1932. Observation in Chiklishar Region—Melitopol Gas Region. A. Kosygin.

These are entirely in Russian, except for the titles and authors in English.

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Geology.

394. Geology of Black Knob Ridge, Oklahoma. T. A. Hendricks, M. M. Knechtel and J. Bridge. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 1–19.—Black Knob Ridge lies at the W. end of the Ouachitas and 15 miles E. of the E. end of the Arbuckles. Rocks in S.E. Oklahoma belong to two different facies, and those present in Black Knob Ridge belong to the facies characteristic of the greater part of the Ouachita mountains, rather than to that characteristic of the Arbuckles. They have been thrust some 20 miles N.W. along the Ti Valley and Choctaw faults, and now overlie rocks of the Arbuckle facies. S. E. C.

395. Structure of S.E. Part of Tejon Quadrangle, California. T. Clements. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 212–232.—This area lies between the Santa Ynez–San Rafael ranges on the W. and the Mohave desert on the E., and is of interest for its relation to nearby producing areas.

The crystalline complex which supplied the material from which Tertiary sediments were derived is probably of Jurassic age. The sedimentary rocks range in age from Palæocene to Recent. There are three major structural units which trend approximately N.W.–S.E., parallel to the nearby San Andreas fault. These are the Red Rock Mountain unit in the N.E., composed mainly of crystalline rocks and bounded on the S.W. by the Clearwater fault; the Castaic unit, composed mainly of sedimentary rocks and bounded on the N.E. and S.W. by faults; and the Piru unit, which includes sedimentary and crystalline rocks and the western limit of which is as yet undetermined. The important features of the major faults and folds are indicated. In general, the structural features point to compression having been dominant for long periods. Uplift was probable at the time of the intrusion of the Jurassic batholith and also at the end of the Mesozoic. In Plio-Pleistocene times the compression was marked by shearing, whilst there are indications of general uplift in the late Pleistocene.

S. E. C.

396. Method of Impregnating Porous Materials to Facilitate Pore Studies. A. W. Walds and S. T. Yuster. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 259–267.—The impregnating material is natural, paper-filtered balsam which has been deeply coloured with an oil-soluble dye. A chip of the rock to be examined in thin section is placed in a porcelain crucible with some pieces of the balsam, and the crucible is then put in a steel vessel. This vessel is evacuated as completely as possible and then heated electrically until the balsam melts and covers the rock. A pressure of about 75 lb./sq. in. is next applied and the temperature allowed to rise to 300° F. After standing for an hour or more under pressure the rock is removed, cooled, sliced and mounted in the usual way. S. E. C.

397. Physical Characteristics of Bartlesville and Burbank Sands in N.E. Oklahoma and S.E. Kansas. C. Leatherock. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 246–258.—The study of samples of these sands from wells and outcrops, as well as of samples of sands from Pleistocene beaches in the Dismal Swamp and from off-shore bars in Virginia, was undertaken during investigations on the origin of the Bartlesville and Burbank sands.

The Bartlesville and Burbank sands are predominantly fine-grained, 0·125–0·25 mm. diameter, and the finer portions are sub-angular to angular in shape, whilst the coarser are sub-rounded to rounded. They are composed mainly of quartz particles which are usually loosely cemented with a mixture of Mg, Fe and Ca carbonates. Secondary silica is prevalent, and suggests that silica forms at least part of the cement in many localities. There is an abundance of detrital rock fragments—chert, shale and schist—and grains of black, carbonaceous material in varying quantities are ubiquitous. Fossils are very rare. In general, the two sands are so similar that it is impossible to differentiate them with certainty. S. E. C.

398. Origin and Distribution of Bartlesville and Burbank Shoestring Oil Sands in Parts of Oklahoma and Kansas. N. W. Bass, C. Leatherock, W. R. Dillard and L. E. Kennedy. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 30–66.—Bass's work on the shoestring sands in Greenwood and Butler counties, Kansas, has now been extended to cover similar sands in Cowley Co., Kansas, and Kay and Osage Cos., Oklahoma. Modern offshore bars on the coasts of N. Carolina, Virginia, Maryland, Delaware and New Jersey, as well as Pleistocene beaches on the W. shore of the Dismal Swamp (S. Virginia and N. Carolina), were also examined.

The Bartlesville and Burbank sands are really sand zones in the Cherokee shale (Lower Pennsylvania). The Bartlesville sand is a series of sand bodies occurring in a zone 150–200 ft. thick, in its lower half, whilst the Burbank sand is a similar series somewhat higher in the formation. The individual sands in one series are not necessarily of exactly the same age.

Detailed comparison of the characteristics of these sand bodies with those of modern offshore bars—distribution in narrow, more or less straight zones; ridges on the surface of the sand bodies; shape of the sand bodies; composition, grading and shape of the sand grains; bedding; occurrence of marine fossils, etc.—leads to the conclusion that the shoestring sands are fossil offshore bars, and not sand-filled stream channels. On a basis of this conclusion, suggestions are made for the future prospecting in the area. S. E. C.

399. Reconnaissance Geology in State of Anzoatequi, Venezuela. M. Kamen Kaye. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 233–245.—Anzoatequi is in E. Venezuela, and is bounded on the N. by the Caribbean Sea and on the S. by the Orinoco river. The Orinoco marks the northern boundary of Archean (?) granites and gneisses, which are probably part of the Brazilian shield. With the exception of sporadic occurrences of quartzites and semi-schistose material, the Palæozoic rocks were removed by erosion. Lower, Middle and Upper Cretaceous sediments are probably present. The unconformity between the Cretaceous and Eocene which was postulated by Liddle seems doubtful. The typical Eocene sediments are massive, ripple-marked sandstones with interbedded shales and clays. These are followed by orbitoidal limestones which are Upper Eocene or Oligocene in age. Lower Miocene is known in only one locality. The Middle Miocene is represented by sands followed by a shallow-water, marine series which passes upwards into massive soft sands and clays (Upper Miocene). Post-Miocene and Recent strata are relatively thin, and consist of gravels, clays and sands.

Palæozoic sediments were probably derived from the igneous complex to the S. Uplift and erosion then removed these sediments from central and S. Anzoatequi, but transport may still have been northerly. Uplift in the N., with a reversal in the direction of transport, began in Mesozoic time, but was not important until after the beginning of the Tertiary.

The aid given by heavy mineral residues in the reconstruction of the Anzoatequi geosyncline is indicated. The application of seismic surveying methods to the determination of the configuration of the basement is also discussed, and the results obtained by reflection and refraction methods are compared. It is concluded that in the survey

of large areas both are necessary, refraction methods being used to give data on density and velocity and reflection methods for checking and detail. S. E. C.

400. Geological Exploration Between Upper Jurua River, Brazil, and Middle Ucayali River, Peru. V. Oppenheim. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 97–110.—The area covered lies between Cruzeiro do Sul on the upper Jurua (Brazil) in the E., Contamana on the middle Ucayali (Peru) in the W., Reguena in the N. and the Abujas in the S. Most of it is low and swampy and covered with jungle. The first range of hills, the Serra do Moa, lies 100 km. W. of Cruzeiro do Sol, and extends in a N.N.W. direction. 100 km. to the W. of the Serra do Moa is the Serra de Contamana, a spur of the Cordillera Oriental of Peru. Yet another 100 km. to the S.E. of the Serra de Contamana is a group of uplifts known as the Cerros de Utuquina. Another range of hills farther S. has apparently not yet been explored.

The sediments range in age from Lower Cretaceous to Pleistocene. The oldest rocks in the region outcrop in the Serra do Moa, and are the Moa sandstones. These may be tentatively correlated with the Pongo sandstone in Peru, and would thus be Lower Cretaceous in age. They are followed by blue and grey shales, calcareous sandstones and thin limestones. This formation is overlain by the Sungaru sandstone, which is lithologically similar to the Huancanqui sandstones of the Pongo de Manseriche. There then follow the Cruzeiro red beds—red clays with limestones, shales and sandstones—which are of wide extent. Their age is probably Upper Cretaceous to Middle Tertiary, and they probably form part of the Cretaceous–Tertiary belt which extends along the foothills of the E. Andes. The Aquidam beds, clays with cherty concretions, may be Pliocene. Quaternary and recent sediments are of vast extent.

The structure of the area corresponds with the physiographical features. The Serra do Moa is an anticline striking N.N.W., and, on the upper Moa, the W. flank with a dip of 30–40° is considerably the steeper. The Serra de Contamana seems to be a monoclinal structure broken by N.–S. faults. Numerous seepages occur in the Contamana district, but none was observed in the Serra do Moa region, due possibly to its being less affected by faulting. The latter district thus appears to be worthy of more attention. S. E. C.

401. Studying Present Earth Surface Reveals Past Geological History. W. V. Howard. *Oil & Gas J.*, 4.3.37, **35** (42), 13, 14 & 22.—The search for new oilpools associated with old shore-lines and buried unconformities depends largely on the preservation and detailed examination of well-cuttings, cores, etc., and a study of present shore-line conditions. The author suggests that the submergence of low-lying areas such as Florida would be accomplished with little marine erosion, and after burial would form potential reservoirs.

The distribution of the Hunton Lime, Wilcox Sand and Woodbine Sand are discussed, and it is suggested that future work should be devoted to the preparation of detailed Palæogeographical and Palæogeological maps which would show more clearly important breaks in the succession. J. A. G.

402. Micro-Palæontologic Analysis of Jackson Eocene of Eastern Mississippi. E. Monsour. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 80–96.—Detailed lists are given of the micro-fauna from the measured section in the Jackson group (Eocene) between Garland Creek and Shubuta Bridge in Clarke and Wayne counties, Mississippi.

Three horizons are recognized in this section: *Lenticulina* horizon, *Pecten–Bryozoan* horizon, and Lower Jackson. The *Lenticulina* horizon is related to the Red Bluff Oligocene as well as the Upper Jackson, whilst the *Pecten–Bryozoan* horizon may represent all or only a part of the Middle and Upper Jackson of Louisiana–Texas. S. E. C.

403. Sandstone Porosities in Palæozoic Region in Arkansas. G. C. Branner. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 67–79.—Samples of unweathered sandstones were taken in the Ouachita mountains, the Arkansas valley and the Ozark plateaus, and the porosities of the samples determined. The average porosity of the sandstones reflects the degree of deformation in the area; it is 5·7% in the intensely folded strata in

the Ouachita mountains, 7·8% in the less strongly folded strata of the Arkansas valley, and 10·9% in the little deformed strata of the Ozark plateaus. There appears to be a definite relationship between the average porosities of the sandstones and the carbon ratios of the associated coals. S. E. C.

404. In Search of Reserves in the U.S. Anon. *Rev. Petr.*, 20.2.37 (723), 243.—Some of the companies in the U.S. feel that they may soon have difficulty in supplying demands, and an impetus has been given to prospecting.

Rodessa, the only big discovery since 1935, lies on the Louisiana–Texas border. While the Louisiana section has been defined, extensions have been made to the north in Texas, and its importance exceeds that expected.

In Oklahoma Fitts field was the last big discovery, and despite geological work S.E. Oklahoma remains an enigma, whilst in Kansas large unprospected areas remain.

In California search for gas is being made in the San Francisco Bay region, and oil search in Kern County.

Texas still offers the best prospects, and much geophysical work has been done. The testing of this may be expected soon. R. O. Y.

405. Oil in the Argentine. Anon. *Rev. Petr.*, 31.10.36 (707), 1613–5; 7.11.36 (708), 1647–50. Summary from Y.P.F. report, 1935.—Prospecting in the Chubut and Santa Cruz areas nears completion. Work has also been done in the Nequera and La Pampa areas and the Provinces of Mendoza, San Juan, de Jujuy and Salta, with generally hopeful results. Reconnaissance and aerial reconnaissance have been done over wide areas. Gravimetric and seismic surveys have been carried out at Jujuy and Santa Fé and magnetic in Nequa area. Much geological research on porosity, permeability and saturation has been done on the known fields. In Comodoro Rivadavia deep exploration pits have led to the discovery of more productive nappes, and some production is obtained from these shafts. Similar work has given fairly good results at Salta, Mendoza and Plaza Haincul. Exploitation work at Comodoro Rivadavia has revealed a deeper producing zone which may also be available in the Gulf of San Jorge region. R. O. Y.

406. Aerial Geology. Anon. *Rev. Petr.*, 16.1.37 (718), 79.—A review of the first publication of the aerial geology section of the Am.I.M.M.E. (No. 756).

By this method faults, changes in slope, lithology and strike may be distinguished. At 3000–7000 metres features show up which are lost in detail at the surface, and features which seem scattered and without system on the surface assume a continuity when seen from a height—for instance, fault tectonics.

Attempts have been made to use colour photography, but difficulty of reproduction remains a drawback. The old difficulty of the pilot not being able to keep a quite straight course has been overcome by the use of a device known as a "solar navigator." This results in an economy in "shots" when surveying unknown territory.

Costs vary from $2 to $50 per sq. mile. On a 2″ to the mile scale in the U.S.A. the cost is $4, and in colonial countries $8–$16 per sq. mile. R. O. Y.

407. Analogies Between the Structural and Petroleum Geology of the Sub-Carpathian and Southern Riff Regions. J. Lacoste. *Compt. rend.*, 9.11.36, **19** (203), 945–947.—In these two regions the mechanisms of the structures are essentially the same. In Roumania squeezing took place between the jaws of the Carpathian nappes and the Dobrujean block in the path of the under-thrust, while in Morocco squeezing occurred between the Spanish meséta and the backward part of the Riffian limestone together with the Moroccan massif. In both instances glide movements took place in the reverse direction to the general tectonic under-thrust. Lithologically in both cases there is much plastic material; in Roumania the Cornu beds (Salifère–Aquitanian) and the Cretaceous marls of Morocco, both containing salt and gypsum. In Morocco, however, the facies are more heterogeneous and the pre-Cretaceous is much more competent than the formations at corresponding depth in Roumania. Thus the S. Riff basin is broken up more than the Roumanian Plain region. Just as several sources are cited for Roumanian oil, so the author gives two for the Moroccan oil: (1) The clays and

sand flysch facies of pre-Riffian age (seepages are very abundant in the Cretaceous marls). (2) In the limestone horizons of the wrinkled foreland we have possible source beds. R. O. Y.

408. Structural Trends May Furnish Clues to Future Oilfields. W. V. Howard. *Oil & Gas J.*, 11.2.37, **35** (39), 28–30.—Lack of information concerning the genesis of structures limits the ability of the geologist to forecast the likely direction of structural trends. It is, in fact, not always easy to find sufficient evidence to postulate a trend with certainty. Almost any line drawn through an area such as the Gulf Coast Region will connect several productive salt domes, but this cannot be accepted as sufficient evidence.

Greater attention should be given to lateral variations in sediments, more particularly those associated with shore-line conditions. It is probable that during the formation of large sedimentary basins more than one shore-line was developed and subsequently buried. Future exploration should be directed to the search for these older shore-lines in the interior of the basins. J. A. G.

409. Possibility of New Oil Pools in the Siliceous Lime and Bartlesville Sand in T.23 N., R.10 E., Osage County, Oklahoma. N. W. Bass, W. R. Dillard and J. H. Hengst. *U.S. Geol. Survey Bull.*, 1936, 886–*A*, 1–4.—This Bulletin gives a preliminary account of the results of subsurface records made in various localities in the Osage Indian Reserve, recently obtained by the U.S.G.S.

The Bartlesville Sand—which is productive in several districts—occurs throughout wide areas in N.E. Oklahoma in characteristically narrow lens-shaped bodies which have yielded large quantities of oil. Drilling in these sections has reached 1900–2100 ft. The presence of oil-bearing Bartlesville Sand in parts of N.W.¼ Sec. 16 and the N.E.¼ Sec. 17 is therefore strongly indicated.

In various other sections (shown on a subsurface structure contour map) small domes in the Siliceous Lime have been very productive. Additional domes, so far untested, in the Siliceous Lime and Oswego Lime are also considered favourable for oil production. From experience gained in other wells in the region, it is thought that if oil is found, acid treatment of the reservoir beds will much increase the yield. G. S. S.

410. Jefferson Major Discovery Structure Rivals Rodessa. M. Tucker. *Oil & Gas J.*, 11.2.37, **35** (39), 21–22.—The recently completed well north of Jefferson in Marion Co., Texas, and 13 miles S.W. of Rodessa, may have proved an area of greater potential yield than Rodessa. The well is located on a fault which is probably associated with that at Rodessa, but all available evidence points to the two fields being entirely separate accumulations. The producing horizon at Jefferson is part of the Glen Rose Series below the Anhydrite, and is comprised of an upper 14 ft. of sand and about 50 ft. of sandy limestone, separated by an impervious oolitic limestone. The fault has an excellent closure and a throw of 750 ft.—about 200 ft. more than at Rodessa.

It is probable that there is a series of *en echelon* faults in this area trending in approximately the same direction, and providing that some of them have good closure, further discoveries are probable. J. A. G.

411. Illinois' Future Improved. H. Easley. *Oil Weekly*, 1.3.37, **84** (12), 40–43.—The recent discovery of a new field near Patoka, Illinois, has directed increased attention to the Eastern Interior, or Illinois Basin, which includes most of Illinois, a large area in S.W. Indiana and much of W. Kentucky. During Pennsylvanian times this was a north-pointing arm of the sea, but later it was closed to the S. by an uplift across it. A map indicates the three major structural features of the basin, which are described. They are the La Salle anticline, running from N. Illinois to S.W. Indiana, The DuQuoin flexure, which trends N.–S. on the W. side of the basin, and the Ozark Spur structure across S. Illinois, which is associated with a fault zone to the E. All these structures carry some oil, and great interest is being shown in the area which they enclose.

Surface mapping is unsatisfactory, largely on account of the glacial deposits which cover most of the area. The subsurface geology is discussed briefly, and it is pointed

out that the beds will thicken and change in lithology towards the axis of the basin and to the S. To date, insufficient geophysical work has been done to define fully the underground conditions. The article concludes with some mention of leasing operations, recent discoveries and drilling planned or in progress. A. J. H.

412. Geology of the Fitts Pool in Oklahoma. K. R. Teis and M. Teis. *Oil Weekly*, 1.3.37, **84** (12), 18–26.—The Fitts pool covers an area of over 5000 acres, and production is obtained from eight horizons, as follow: Shallow sands in McAlester and Atoka formations of the Pennsylvanian, Cromwell or Union Valley sand (Pennsylvanian), Hunton lime group, Viola, Viola–Bromide, Viola–Bromide–McLish, Wilcox, and Oil Creek sands (all Siluro-Devonian). The stratigraphy is described in detail and a generalized section presented.

The surface structure is a triangular downthrown block, the limiting faults converging to the W. The subsurface structure is an E.–W. trending anticline limited by normal faults, except on the N. side. Three structure contour maps accompany the article, and a section illustrates some features of the faulting which are described.

A. J. H.

413. Alaska May Be of Importance. P. S. Smith. *Oil Weekly*, 22.2.37, **84** (11), 82–94.—In Alaska there are three extensive areas offering hopes of oil production that have not yet been tested adequately. The Katalla–Yakutat area is marked by Tertiary outcrops, moderate folding and faulting in the main, and many seepages. Some high-grade paraffin base oil has been produced at Katalla, the possible source of which is discussed.

Along the E. part of the Alaska peninsula from Chinitna Bay S.W. to Chignik seepages are found from outcrops of Middle and Upper Jurassic age, mainly Tuxedni sandstone and Kialagvik formation, in places overlain unconformably by Chinitna and Shelikof formations. Several possibly oil-bearing structures are known. The source of the oil in this region is thought to be in the Tuxedni sandstone.

The third area is near Smith Bay, E. of Point Barrow. Only reconnaissance work has been done, but a seepage has been found in beds of Upper Cretaceous age, which become successively more folded away from the coast. It is suggested that the source of this oil is in the Lower Cretaceous, although objections to the suggestion are admitted. A. J. H.

414. Stratigraphy and Oil and Gas Prospects of East-Central Alberta. G. S. Hume. *Can. Inst. Min. & Met. Bull.*, Febr. 1937 (298), 126–140.—The district described embraces the region from Viking E. to the Saskatchewan boundary and from North Saskatchewan river S. to Coronation and Monitor.

The greater part of the area is covered by drift, in some places having a thickness of over 50 ft., and rock outcrops are therefore relatively few and often widely separated. The oldest beds—proved by drilling—are Palæozoic limestones which are overlain by Jurassic and Cretaceous deposits. The actual age of the upper beds of the Palæozoic (which is an erosion surface) is uncertain, and opinions differ as to whether these rocks are Mississippian or Devonian. This question is said to be of extreme importance, as production of oil in the Palæozoics of S. Alberta in the Oyen is obtained from Mississippian strata, whereas no production has yet been reported from the Devonian in any part of the Prairie Provinces of Canada.

In the Viking field, gas is produced from a sand (125–150 ft. thick), which occurs fairly extensively in the area above the base of the Upper Cretaceous shales. From presumably the same horizon, gas is also produced in the Fabyan field a few miles N.W. of Wainwright. Although other horizons also produce small quantities of gas, no commercial production has been obtained.

The stratigraphy and structure of beds of Montana age are discussed in connection with possible production. These deposits consist mainly of sandstones, sands and shales: an upper series, the Variegated Beds, and a lower, the Birch Lake Formation. The latter is followed by other similar deposits, which are briefly outlined. Changing lithological characters from place to place renders it very difficult, if not impossible, to make exact correlations, or even to determine in some cases the formation to which an isolated outcrop may belong. Therefore, the author remarks, it is not surprising

that the location of favourable structures for oil and gas in East-Central Alberta are so few. In the area from Viking to the Saskatchewan boundary, however, many gentle folds are thought to be present, and others, although not yet discovered, may also be reasonably expected.

A final section is given on the use of geophysical methods. Recently several reflection seismographs were operated in Alberta, and during the summer of 1935 the Battleview anticline crossing Battle river was discovered. A study of the structure by this method has, it is understood, revealed much more information in regard to amount of dip and position of the anticlinal axis than was hitherto determined from surface operations. By geophysical investigations it is thought that much of East-Central Alberta will now receive attention, the more so if oil wells are obtained in areas like the Battleview anticline, which is already considered favourable for prospecting purposes. G. S. S.

415. Future Oil Possibilities of Virgin Regions Call for Drilling in Brazil. V. E. Oppenheim. *Oil Weekly*, 22.2.37, **84** (11), 108–121.—This article describes the four main areas in Brazil in which the search for oil has been conducted.

The Parana Basin contains a few Lower Devonian outcrops, but mainly the series of Lower Permian to Upper Triassic sediments and diabase traps known as Gondwana rocks. These are fractured by many faults with a W. downthrow, usually associated with the diabase occurrences. The only traces of oil found in the Gondwana system seem to be derived from bituminous shales of the Iraty horizon. The possibility of oil in the underlying Devonian rocks is mentioned.

In the coastal area of Alagoas the formations are Tertiary in age. Occurring below the Barreiras formation, the Alagoas series (Eocene), consisting of shales with bituminous impregnations, are the only rocks to be considered as possibly petroliferous in this area. The general conditions are regarded as unfavourable for much commercial production.

A number of wells have been drilled in the Lower Amazon area, and traces of oil and fair quantities of gas have been found in the Curua and Maecuru formations (Lower Devonian).

According to the author, the most likely oil-bearing region is in the territory of Acre, which is mostly covered by Tertiary and Upper Cretaceous rocks, with Lower Cretaceous (?) sandstones exposed on the Serra do Moa anticline. Oil-bearing formations and seepages are known to exist, and although little exploratory work has been done, conditions are thought suitable for good production from the Cretaceous.

The article is furnished with a number of maps, sections, tables and photographs. A. J. H.

416. Determine Holland's Future. T. Reinhold. *Oil Weekly*, 22.2.37, **84** (11), 96, 98.—Indications of oil in Holland are confined to the E. part of the country, geologically a prolongation of the N.W. German Basin. The geological conditions are compared with those of the Gulf Coast region of America. Well-developed Carboniferous beds are overlain unconformably by the Permian Dyas (Zechstein), and are cut into blocks by large faults and overthrusts. The uplifted blocks containing salt sometimes resemble the German salt domes, but their origin is different. The subsurface geology is not well known, and geophysical exploration would be of material assistance. Oil has been encountered in the Zechstein dolomite, which most Dutch geologists believe to be the source-rock for the whole of the basin, and there are possibilities of oil production along the German–Holland frontier between Winterswyk and Oldenzaal. This part of the W. border of the basin is limited to the S.W. by an important S.E.–N.W. fault. The Saxonic fold trend lines will have to be considered together with the folds in the search for oil in Holland. Towards the W. and N. the basin dips to a great depth, where it is probably much faulted, and oilfields may be found along the lines of these faults. A. J. H.

417. Geology's Rôle in the Exploration for Oil in Australia. E. A. Rudd. *Oil Weekly*, 22.2.37, **84** (11), 122, 124.—Apart from small production at Lakes Entrance in Victoria, the only signs of oil encountered have been wet gas and paraffin wax in Queensland and bituminous impregnations in Devonian limestone in W. Australia.

With no surface indications of oil, the search has consisted of the location of wildcats by geological reasoning in selected sedimentary basins. The regions receiving attention are described, these being the Kimberley area and N.W. Basin (W. Australia), the Gippsland Basin (Victoria), the Sydney Basin (N.S.W.), and the Roma–Springsure area (Queensland). The chief problems faced by the geologist are mentioned, and a new method of mapping is briefly described. A. J. H.

418. Oil Prospecting in Szechuan Province. C. H. P'An. *Oil Weekly*, 22.2.37, **84** (11), 134–146.—Small amounts of oil occurring in brine wells have shown that oil does exist in the Szechuan red basin, but no drilling for oil has yet been done. The basin, which is composed of rolling synclines, anticlines and domes, is almost entirely covered with Cretaceous red beds, except for outcrops of older beds along anticlinal axes and on the edges of the basin.

The stratigraphy is described in detail. The Cretaceous red beds are subdivided into Mengshan, Chiating and Tzuluiching formations, the total thickness being about 2500 m. They are underlain by 550 m. of the Hsiangchi Coal series (Lower Jurassic), which overlies unconformably the Chialingchiang formation (Triassic). This, consisting mainly of limestone, generally occurs along anticlinal axes, and is gradually replaced by the Patung series of Upper Triassic shales and limestones about 650 m. thick. Underlying this is the Feihsienkuan formation, about 200 m. of shale, sandstone and impure limestone. There are about six petroliferous horizons divided equally between the Upper Triassic, the Lower Jurassic and the Lower Cretaceous. The Chialingchiang is the main petroliferous horizon, although the Penglaichen oil-producing horizon is undoubtedly Lower Cretaceous, and oil seepages at Shihyukou and Shuichiats'ao probably come from beds of the same age.

Recommendations are made for drilling on the Shihyukou anticline, which runs N.–S., pitching slightly to the N. A seepage to the W. of the axis has yielded a poor oil of 0·92 specific gravity. Drilling is also recommended on the Tahsien dome, which is elongated N.W. by N.–S.E. by E., and which the author regards as two distinct anticlines. A small seepage here produces a better oil than that at Shihyukou. A little oil has been produced from the Penglaichen field, the structure of which is a very gentle brachy-anticline. The possibilities of commercial development depend very much on the success or failure of drilling at Tahsien and Shihyukou.

The author points out the similarities between the petroliferous areas of Szechuan and N. Shensi. The latter area has eight petroliferous horizons, which are enumerated and discussed. Although the oil horizons of N. Shensi are richer than those of Szechuan, the lack of favourable structures renders commercial development less likely.

The article is accompanied by a map and three sections. A. J. H.

419. Djebel-Tselfat Gusher (N. Africa). Anon. *Rev. Petr.*, 27.2.37 (724), 271.—Exploitation of the Domérian zone at Djebel-Tselfat began in 1934. A recent well came in at 100 metric tons per day, and good results have been obtained.

The productive zone is limited by two faults, and is only about 200 m. wide, but the length has not yet been defined. In the central block thrusting or overfolding gives repetition of the Domérian in one well which was drilled below the usual producing horizon. It is hoped that the producing zone may also be reached at a reasonable depth on the flanks.

Similar work is going on at Bon Drâa and Bab Tisra, neighbouring anticlines. R. O. Y.

Geophysics.

420. Interrelationship of Geology and Geophysics. O. L. Brace. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 197–211.—The basic principles of the gravitational and seismic methods of geophysical surveying are summarized. The various geological factors which affect the interpretation of geophysical surveys are then discussed, and the need for an extensive knowledge of stratigraphy and regional and local structural conditions is pointed out. It is suggested that a geologist should be in charge of any oil-prospecting campaign, that a field geologist should accompany each geophysical field party, and that a geologist should assist in the interpretation of the results of the survey. S. E. C.

421. Geophysics—its Application to Petroleum Prospecting. J. B. Eby. *Petr. Eng.*, Feb. 1937, **8** (5), 113–134.—Until the advent of geophysics there was no method of determining subsurface structure where all surface indications are lacking. Geophysical methods have changed this. The principles underlying the use of the torsion balance, gravimeter and pendulum and the history of their development and use are outlined. The seismograph, which is of great importance in geophysical exploration, is treated similarly. It was Mintrop who first put it to commercial use. The general method of locating salt domes seismically is by long-distance shooting (4–7 mls.) using refracted waves. Salt domes give abnormal velocities. Seismic work in U.S.A. is now almost wholly reflection, by which method it has been possible to map subsurface structures which could not be resolved by refraction shooting.

Since salt domes have less magnetic material than the surrounding sediments, they will give negative anomalies, but generally the magnetometer is not very successful with them. As further geophysical methods the measurement of radioactive emanation and the hydrocarbon content of subsoil gases is now receiving attention.

G. D. H.

422. Prospecting for Oil Structures by Electrical Methods. J. J. Jakosky and C. H. Wilson. *Petr. Eng.*, Feb. 1937, **8** (5), 143.—The resistivity of the subsurface is measured by passing an electric current between two electrodes, the separation of which determines the depth of penetration. Since the current is carried by the water in the rocks, the interpretation of the measurements must take account of the vertical and lateral distribution of the ground waters, their chemical composition, and the subsurface temperatures. The potential drop in this conduction is greater than predicted by Ohm's law. As a rule the relationship of current to potential is exponential, but it varies with the subsurface materials. Hence it is usual to maintain a constant current density per unit volume of material or systematically to vary the current as the volume of material changes.

The distribution and nature of the subsurface moisture vary with the stratification. Where the beds are non-uniform lithologically, the separation of the electrical stations must be small (1000–2000 ft.), as in California, but in uniform areas, like the mid-Continent, they may be a mile or more apart. The resistivity changes rapidly with the water content up to about 10–15% of water, and then changes but little. It also varies with the time of flow of the current. The best results are obtained using short times. The depth of penetration is 25–35% of the electrode separation, depending on the materials. The current distribution is determined electrically or magnetically.

The analysis of the data is similar to a Schlumberger log, and the structure may be determined from the points of inflection. Using the tri-directional system of measurements the dip and strike can be measured for different beds.

The method has been used in swampy areas, faulted areas, and where there is a thick alluvial cover. G. D. H.

423. Instruments and Operating Procedure in Geophysical Prospecting by Gravity Methods. G. Stubbe and K. H. Schmidt. *Petr. Eng.*, Feb. 1937, **8** (5), 137.—The principles and construction of the torsion balance are briefly described, including the Eötvös–Schweydar instrument with its photographic recording and clockwork mechanism for changing the positions of azimuth, so making its operation automatic. A further development was the smaller, lighter Z-beam instrument, which is better suited for difficult territory. The latest development in this direction is the use of an inclined beam. These three types have sensitivities of $0{\cdot}92 \times 10^{-9}$ to $1{\cdot}5 \times 10^{-9}$ c.g.s. units per 0·01 cm. deflection on the photographic plate. The field procedure and computation of results are outlined.

The gravimeter is treated similarly. It has the advantage of not being affected by nearby masses, facilitating the choice of stations, but the elevation must be determined to an accuracy of 1 or 2 ft. The pendulum method is also discussed, but this is not popular in geophysical prospecting.

At present the torsion balance is the most practical and reliable instrument, but improvements in the gravimeter will undoubtedly increase its value. Gravity methods are valuable in broad as well as detailed surveys, and their operating costs are not prohibitive. G. D. H.

424. Application of the Geo-Sonograph to Petroleum Exploration. F. Rieber. *Petr. Eng.*, Feb. 1937, **8** (5), 140.—In this device the many reflections from complex structures are photographically recorded on ten separate sound tracks on a film. When these are sorted out and transcribed by a photoelectric analyser, it is possible to identify and use reflections which would otherwise be unrecognizable. It has been developed for work in regions where the ordinary reflection seismograph yields confused records, but is not limited to such. The confusion arises on certain types of structure which inevitably return a complex pattern of waves which cannot be distinguished separately on the ordinary visual records. When initially recorded on a sound track the confusion remains, but is capable of analysis in the sonograph analyser. The sonograph film from the field is passed slowly through an optical system with a photo-cell which is set to respond principally to waves reaching the earth's surface from a known direction, and records them on a drum. The process is automatically repeated for other directions, and from the series of records so made the times of arrival of the various components can be seen. A selection is made between the adjacent analyser traces, and that on which any given wave appears at its maximum amplitude is chosen as representing the true direction of arrival. G. D. H.

425. Reflection Seismology in Exploring for Potential Fields in Poland. Z. A. Mitera. *Oil Weekly*, 22.2.37, **84** (11), 164.—A map is given the localities in which the different geophysical methods are being used. Reflection seismology is being used for structures several thousand feet deep, in addition to gravity and magnetic methods. Seismic work in the Marginal zone and also within parts of the Carpathians embracing the oil pools of Boryslaw, Bitkow, Rypne and Majdan shows a lack of uniform or correlating beds, and so only dip shooting has been used. Even the Menelitic shales and Hornstone beds do not show clear and persistent reflections. The geological complexity with the repetition of beds does not favour the use of reflection seismology, and the steep dips are a further difficulty in field technique. It has been possible to determine the dip and strike of reflecting horizons by shooting in two directions at right angles.

Geological conditions are better in the sub-Carpathian depression between the Carpathian range and the Podolian plateau—the Carpathian foreland. The alternating clay-shale-sand series with hard gypsum and sandstone beds provides good markers. Shot depths vary from 10 to 100 ft. Near Stryj good reflections were obtained from a 90-ft. gypsum bed at about 3500 ft., and these outstanding reflections have been traced throughout several thousand square kilometres in the foreland.

It has been possible to construct contour maps of reflecting horizons in this alluvium-covered area.

Experiments in winter on frozen and snow-covered ground have shown that the dynamite charges can be reduced, and that the seismic energy penetrates to deeper beds more easily than in summer. G. D. H.

426. Use of Multiple Seismometers. E. McDermott. *Petr. Eng.*, Feb. 1937, **8** (5), 135–136.—Five years work on the use of multiple seismometers has established their advantage for discriminating between reflections and undesirable disturbances—ground wave, wind and traffic. Under average field conditions, using eight instruments, the discriminating factor may be at least three, and even greater where the wave-length of the ground-wave is measurable. In a case considered, eight instruments, connected in series, are set in line, distributed at intervals of one-eighth of the ground wave-length, with the first 1000 ft. from the shot point. The output of the seismometers is amplified and photographed. For a bed 6000 ft. deep and dipping at 10° the maximum difference in time of arrival will be small as compared with the period of the reflected wave, and the resultant will be almost eight times that of a single reflected wave. The other disturbances reaching the seismometers will tend to cancel out. The wave-length of the ground-wave seldom exceeds 200 ft., and with the instruments spread over this distance a considerable amount of cancellation will still occur. For dips over 20° the seismometer interval must be shortened. Even in extreme cases of variation in thickness or velocity of the weathered surface layer there is still the possibility of almost 100% summation.

In actual field practice six or more groups of seismometers would be photographed on the same record. G. D. H.

427. Electrical Logging and its Applications in Modern Petroleum Prospecting. Anon. *Petr. Eng.*, Feb. 1937, **8** (5), 155.—The Schlumberger process measures the resistivity and what is ordinarily termed the electrical porosity (due to spontaneous polarization currents, which are most intense opposite porous horizons). These two factors are recorded simultaneously, and permit subsurface correlation in addition to indicating whether a sand is likely to contain gas and oil or salt water. Recently the continuous recording of temperature with depth has become possible and gives further data as to the possibility of oil, gas and water horizons as well as being able to locate the top of setting cement behind casing.

Another method of electrical logging is the geo-analyser using an electromagnetic field impressed on the formations. The results are recorded on a film which may be developed immediately or handed over without the operator of the equipment seeing the results. One of the curves (permeability curve) is a measure of the resistivity and depends on shallow electrical penetration. The other (saturation curve) involves deeper electrical penetration and indicates the type of liquid likely to be in the pores of the rock.

A third method of electrical logging is the Stratograph. It is claimed that this will record the electrochemical characteristics of strata behind casing. G. D. H.

428. Geo-Electrical Measurements in Drill-Holes. S. H. Shaw. *Mining Magazine*, Jan. 1937, **56** (1), 17–23.—Electrical methods of logging drill-holes by resistivity and spontaneous potential measurements, based on those of Schlumberger, are briefly described. The resistivity curves obtained in two comparatively shallow boreholes in the Triassic sandstones of the Birmingham district were satisfactorily correlated, but the natural potentials proved too small for comparative purposes.

Resistivity values ranging from 5000 up to as much as 15,000 ohm cm. occur within the Upper Bunter sandstone alone, thereby indicating a marked absence of electrical homogeneity in the same geological formation. It is emphasized that the resistivity measurements made in drill-holes are likely to be more accurate than surface determinations, because the resistivity of the surface soil does not vitiate the results.

D. W.

Drilling.

429. Progress in Steam-Drilling Equipment. V. W. Smith. *Petr. World*, 1936, **33**, 82–83, 98–102.—The advantages resulting from the use of superheated steam for drilling equipment are discussed, four different set-ups for a 6000-ft. well being considered based on information obtained from tests carried out on the Humble field in Texas and at Chandler, Oklahoma.

The first of these assumed set-ups consists of expanding steam-engine drives on draw-works, rotary and mud pump, together with an integral superheater boiler fully insulated and with steam lines insulated. This plant will give the lowest fuel and water figures at the lowest first cost and weight.

The second set-up is similar to the first, except that it employs saturated steam boilers with a separately fired superheater. The efficiency will be slightly less than the first set-up, because separately fired superheaters do not provide the high degree of superheat at a comparable price or weight. This set-up does, however, have the advantage of modernizing present saturated steam-boiler equipment. Set-up No. 3 consists of integral superheater boilers and the non-expanding type of drilling engine for combination draw-works and rotary drive and duplex type slush pump. With the high degree of superheat available to absorb the uninsulated line losses and reduce the water rate on the steam cylinders, a remarkable reduction in fuel and water can be made. This set-up provides efficient equipment with low first cost, and is desirable where the drilling rig may be used both at points of high and low cost fuel and water.

The fourth set-up is the simple power unit including non-expanding engines and pumps with saturated steam boilers, and it would seem that this set-up would be most desirable where fuel and water costs are negligible. W. W.

430. Pressure Completion Allows Determination of Formation Data. M. Jones, Jr. *Calif. Oil World*, 9.4.36, **28** (38), 13.—Describes the objective for which the set-up was made, the equipment used and the method of operation employed in drilling a 6022-ft.

well in the Rodessa Louisiana area. It was known that a gas cap of rather large proportions existed over the oil reservoir, and it was believed that a water-table lay directly under the oil. This water-table has a source sufficiently great to be of serious detriment unless correct drilling and production methods are used. To secure the best results, the operator must set casing at a sufficient depth to case off that portion of the porosity containing high-pressure gas and very little oil saturation, and must be careful to stay as far as possible above the water-table. A highly technical process of core analysis was chosen for determining the exact depth at which to set the casing. The correct depth to drill into the producing section was determined by frequent flow tests under pressure conditions as they would actually exist in the completed well. Gas-lightened water was used as the drilling fluid. Indications from core analysis showed that the top of the oil saturation was touched at 5998 ft., and after setting 6006 ft. of 7-in. 26-lb. Grade "C" casing, pressure drilling equipment was installed. Bottom-hole pressure was 2700 lb./sq. in., and the well-head pressure rose to between 650 and 750 lb./sq. in. soon after the pumps were started. At this stage oil began to pass with the drilling water into the drilling-water knockout. A 10-ft. core was taken and analysed for porosity, permeability, saturation and chloride content. The purpose of the chloride test was a safety check to determine the presence of salt water, and furnished a means of estimating the position of the water-table. A 6-ft. core was then taken, and preparations were made for completing the well. W. W.

431. Drilling through Heaving Shale. M. Jones, Jr. *Oil News*, 1936, **40**, 89–90.—Description of equipment employed for drilling through heaving shale, using external upset internal flush joint casing as the drilling string. W. W.

432. Turner Valley Drilling Practice. V. Taylor. *Oil News*, 1936, **40**, 30–32.—Short article on the Report for the year ended 31st March, 1935, of the Alberta Department of Lands and Mines. Cable tool and rotary equipment, casing programmes, drilling times, drilling methods and completion methods are discussed. W. W.

433. Characteristics of Oil Well Cement in Use. D. H. Sheldon. *Calif. Oil World*, 16.4.36, **28** (39), 14.—This article is adapted from a paper read at an A.P.I. meeting, for the purpose of stimulating thought and consideration of the various characteristics of cements as they may affect cementing practices. It deals with physical composition, effect of water-cement ratios, agitation of grouts, temperature effects, pressure effects, gel cements, fibrous cement mixtures, quick-set cements and drilling fluids and cementing practice. W. W.

434. Cementing Practices. W. A. Sawdon. *Calif. Oil World*, 14.5.36, **28** (43), 22, also (47), (49), (51), (52), **29** (6), (7), and (8).—A series of eight articles dealing with cementing jobs in which the cement encases a string of casing and in which cement is used for repair work, and covering the conditioning of mud fluid before cementing, conditioning of wall of hole, area of annular space between casing and wall of hole, method of enlarging hole, preparation for repair work, floating equipment, cement shoes and collars, water-cement ratio, influences on cement behaviour, gel-cement, cement retainer and circulation jar, series cementing, repair work and water location, recementing and plugging back operations. W. W.

435. Native Clay Unsatisfactory for Heavy Mud. W. L. Heater. *Calif. Oil World*, 20.8.36, **29** (5), 13.—Careful check of the native California clays made into muds of varying weights, and also a study of these clays with weight material added to bring up the weight to between 90 and 120 lb./cu. ft. indicate that few of them are capable of supplying a sufficient amount of colloidal material for muds up to 100 lb./cu. ft., and that for muds over 100 lb./cu. ft. more suitable results are obtained by using straight weighting material with the colloidal material added in the form of a concentrated, gel-forming type of clay, such as processed bentonite. The reason for this is that it would take hundreds of pounds of average native clay to supply even a few pounds of concentrated colloidal material such as processed bentonite. The author describes how heavy muds made with straight weight material plus a suitable chemical thinner can be easily controlled to produce: a viscosity high enough to bring up cuttings and prevent settling of solids; a viscosity low enough to drop

cuttings in the mud ditch; a thin impervious cake on the walls of the hole, thereby preventing, to a great degree, the permeation of water into the formation. W. W.

436. Netherlands Responsible for Core-Drilling Method used in Modern Exploration. W. A. J. M. van Waterschoot van der Gracht. *Oil Weekly*, 22.2.37, **84** (11), 184.—The author suggests that the present type of preliminary core drilling originated in Holland. A great deal of the shallow exploration of subsurface conditions is being done by the B.P.M. in Netherlands East Indies with extremely practical portable outfits weighing about 5100 lb. complete and capable of going to 2500 ft. His theory is that present deep-drilling technique will permit exploration to determine possibilities of Palæozoic petroleum in parts of Westphalia, the Netherlands and Belgium.
L. V. W. C.

437. Use of the Viscosimeter on Determining Drilling Mud Viscosity and Gel Strength. M. T. Halbouty. *Oil Weekly*, 15.2.37, **84** (10), 32.—The Stormer viscosimeter has been widely accepted as an instrument for measuring both the viscosity and gel strength of drilling muds, but it has been observed that the viscosity is not a constant quantity. The degree of agitation of the mud varied the viscosity. All determinations must, therefore, be made at one spindle speed. The least error occurs when the spindle speed is 600 r.p.m. A series of charts is given showing the various uses of the instrument.
L. V. W. C.

438. Water-Flooding Work. L. Krause and G. N. Powell, Jr. *Oil Weekly*, 1.2.37, **84** (8), 36.—The coring of an oil sand for water-flood development enables an outline of the total area that can be profitably worked. The reserve available for development can then be determined by multiplying this area by the thickness of the oil sand. Coring may be done either by rotary or cable tools, but if the work is carried out carefully the amount of oil sand footage is determined from the core itself. Saturation samples are then tested in the laboratory by either the retort, gravimetric or extraction methods. Permeability tests are carried out throughout the core by the A.P.I. method. The storage capacity of the sand is obtained by porosity tests also made throughout the cores.
L. V. W. C.

439. Special Equipment Advances Marine Drilling Practices. B. Mills. *Oil Weekly*, 1.2.37, **84** (8), 21.—Many novel reconnaissance, drilling, production and transportation practices have resulted from the development of oilfields along the Louisiana coastline. All transportation is by water and artificial channels are usually required to span the gap between the highways and producing fields.

The drilling barge is perhaps the most interesting result of these operations. The rotary outfits are carried on these great barges together with the heavy steel derrick. The barges are towed into position and sunk by allowing water to enter special compartments. These barges are limited to shallow water and to areas affording an almost level bottom. Corrosion of the barges is reduced by placing heavy creosoted boards around the hull. Pollution of lake, river, bay and canal waters has been reduced to a minimum.
L. V. W. C.

440. Controlled Vertical Drilling is Widely Used in California. T. P. Sanders. *Oil & Gas J.*, 25.2.37, **35** (41), 59.—The present interest in straight-hole drilling by California operators is largely for the sake of saving drilling time, avoiding fishing jobs and reducing wear on drilling equipment. Operators have reached the conclusion that it is cheaper to plug back and redrill a hole 4 degrees off vertical than it is to bring the course back to the vertical by reducing the weight on the bit.

In all localities the bit tends to cut a vertical hole unless a disturbing force is present which may be the result of contacting formations of varying hardness which dip steeply. Where such changes are encountered many operators have adopted the practice of applying little weight to the bit with high rotary table speeds. Speeds as high as 300 revs. per min. have been used, with a usual speed of between 150 and 175 revs.

The use of balanced drill collars has brought about very noticeable results.
L. V. W. C.

441. Well 12,216 Ft. Deep Offers Difficulties in Completion. K. C. Sclater. *Petr. Eng.*, Feb. 1937, **8** (5), 83.—A wildcat well being drilled on the Louisiana Gulf Coast is 12,216 ft. deep, the second deepest hole ever drilled. High gas pressure has been encountered and this is adding to the difficulties of making a proper completion at this great depth.

Drilling has been carried on almost entirely through blow-out preventers. At 11,505 ft. the hole was 6° off vertical. It was plugged back to 10,947 ft. and redrilled. At 11,568 ft. the well was found to be 4° off vertical after straightening had been attempted. Owing to the presence of high pressure gas the weight of the mud was increased to 13 lb. per gallon.

At 12,196 ft. a sand showing gas and oil was found and this sand was subsequently drilled through to the present depth, 12,216 ft. L. V. W. C.

442. Development Operations in the Talco Field. W. H. Grayson. *Petr. Eng.*, Feb. 1937, **8** (5), 90.—The Talco field, Texas, is one year old and shows bright prospects. The majority of wells in this field are brought in after being gun-perforated. A Schlumberger test is usually run to determine how much saturated sand is exposed in the well and at what depth and pipe is set for bottom. Liner is then gun-perforated after the cement has set for 72 hours. This procedure is almost necessary because the reservoir pressure is insufficient to flow wells naturally. One company utilizes the air-lift method of flowing its wells.

Lack of water for drilling is handicapping progress, as no more than two wells can be completed during a month with a single rig. This shortage of water constitutes a serious impediment. Lines are being run from districts situated in some cases 18 miles away. L. V. W. C.

443. Holes Drilled Together Prove Accuracy of Well Surveying. T. P. Sanders. *Oil & Gas J.*, 11.2.37, **35** (39), 57.—An opportunity for checking the accuracy of directional well surveying recently occurred at a well which was being deepened and which drilled through the casing of a neighbouring producing well. The producing well was immediately killed by the heavy drilling mud being used in the deepening operation.

Oriented surveys were carried out in both wells and these showed that the drilling well had drifted into the producing well at a depth of 4018 ft. As a further check a plug was pumped down the producing well and when a measuring line was run it was found that the plug had stopped at the depth indicated by the survey. L. V. W. C.

444. Technique Developed for Directional Drilling in Maracaibo Basin. Anon. *Oil Weekly*, 22.2.37, **84** (11), 99.—It has been considered that the advantage of ease of servicing during the producing life of the directed wells would balance the increased initial costs. An experiment was tried of replacing four existing wells with new wells directionally drilled, from shore locations, to completion points as near as possible to those of the old wells located outside the sea wall. Three methods were employed: (1) to start drilling under an angle with the vertical in the desired direction, (2) to deviate the hole in the desired direction with an oriented and recoverable whipstock, (3) to use various kinds of bits and tools and to apply different weights on the bit. The first method was followed in the first well, the second in the remaining three, with the third method used in all four wells. A fair measure of success was achieved in three of the four wells in that the vertical projection of the bottom of the reflected hole was distant from the old location approximately 46% of the distance between the surface locations. In the fourth well the distance of the vertical projection of the bottom was greater than the distance between the surface locations.

It is concluded from the results obtained that the best and easiest method of control is by setting oriented whipstocks; the "graduated arc" method of orientation is sufficiently accurate; useful adjuncts to whipstocking are weight control, speed control and the selection of drilling assemblies. It is apparently easier to whipstock a hole to the right than to the left. L. V. W. C.

445. Drilling-Time Curves for Analysing Pay Strata. T. P. Sanders. *Oil & Gas J.*, 21.1.37, **35** (36), 43.—A very comprehensive analysis of the condition of the producing

zone and the adjacent section is possible by means of drilling-time curves. These curves, together with data obtained from drill stem tests, electrical well logs, heavy residues from cuttings and from cores, supply all the information required. In making up the curves the time required to drill each 5-ft. section of the hole is plotted. A constant weight is carried on the bit, and since drilling is faster in porous lime than in dense unproductive lime the completed curve shows the condition of the reservoir with respect to relative porosity. L. V. W. C.

446. Portable Rotaries Reduce Drilling Time in East Texas. M. Tucker. *Oil & Gas J.*, 7.1.37, **35** (34), 35.—Unitized light duty rotaries are being used extensively in the East Texas field. Substantial reductions in rigging up time have been made by the use of these rigs which are described. L. V. W. C.

447. Multiple Sands Require Extensive Cement Use in Rodessa. M. Tucker. *Oil & Gas J.*, 21.1.37, **35** (36), 33.—A wide variety of specialty cement work in reconditioning wells has resulted from the multiple producing zones at Rodessa. Gas wells have been transformed to oil wells by squeeze jobs applied to the open hole gas zone of the multiple horizon. The successful application of jobs has been assisted by the advancements made in the manufacture of specially prepared cements, cementing tools and the cementing technique. A slow initial set with greater ultimate strength under high temperature and pressure conditions were the principal objectives. More complete and uniform penetration of porous media together with greater weight of slurry to discourage mud or salt water contamination also make these cements applicable to this special work. In addition they are resistant to sulphate water which provides an increased factor of protection for the casing. L. V. W. C.

448. Complete Portable Laboratory Used in Phillips in Rodessa. M. Tucker. *Oil & Gas J.*, 14.1.37, **35** (35), 61.—The Phillips Petroleum Co. is employing a complete petroleum laboratory on wheels, equipped to make porosity, saturation, permeability and water analyses tests. A physical log is made of each well from the tests carried out and the casing seats determined. L. V. W. C.

449. 11,975 Feet of Casing Set in Louisiana Wildcat. N. Williams. *Oil & Gas J.*, 14.1.37, **35** (35), 30.—What is believed to be the longest string of casing ever to be set has been run by the Continental Oil Co. in the Coastal Louisiana area. It consisted of 11,975 ft. of 5-in. casing. This well also claims the record for the deepest fishing job and the deepest side-tracking job, and at its total depth of 12,216 ft. it is the second deepest test in the world. L. V. W. C.

450. U.S. Patents. E. E. Loring and J. Passafuma. U.S.P. 2,066,409, 5.1.37. A pipe perforator operated by an automatically reversible transmission mechanism. Means for feeding and rotating twist drills to effect perforation.

J. H. Howard and A. C. Catland. U.S.P. 2,066,625, 5.1.37. Core drill.

A. C. Catland. U.S.P. 2,066,671, 5.1.37. Roller bit.

G. H. Williams. U.S.P. 2,066,956, 5.1.37. Automatic coupling for tubing strings.

F. J. Hinderliter. U.S.P. 2,067,009, 5.1.37. Tubing and sucker-rod fishing socket.

E. Burns and H. P. Wickersham. U.S.P. 2,067,377, 12.1.37. Safety joint for drilling strings.

I. A. Morris. U.S.P. 2,067,408, 12.1.37. Apparatus for cleaning a well screen having a closed chamber containing an explosive charge which can be exploded by an impact member dropped from the surface when the container has been placed.

H. W. Millmine. U.S.P. 2,067,499, 12.1.37. Testing device for well equipment in which fluid is admitted into the casing between the blow-out preventer and a packer where it is trapped.

A. A. Hunt and L. H. Adair. U.S.P. 2,067,700, 12.1.37. Sucker-rod adjuster.

O. F. Matthews and S. I. Hill. U.S.P. 2,067,774, 12.1.37. Oil-well pump.

A. J. Penick and K. T. Penick. U.S.P. 2,067,785, 12.1.37. Tubing head.

C. C. Brown. U.S.P. 2,067,885, 19.1.37. A setting tool for well packers.

T. A. Owen. U.S.P. 2,068,108, 19.1.37. Sand-testing tool.

A. C. Catland. U.S.P. 2,068,375, 19.1.37. Roller bit.

D. G. Crandall. U.S.P. 2,068,535, 19.1.37. An instrument for transmitting variable frequency signals to the surface of a deep well through the casing to enable cement plugs to be located. Change of frequency is used to indicate the approximate depth the instrument has travelled down the well.

H. T. Nichols. U.S.P. 2,068,638, 19.1.37. Combined crown and travelling block.

C. S. Crickman. U.S.P. 2,068,659, 26.1.37. Tubing catcher.

L. E. Powell. U.S.P. 2,068,704, 26.1.37. Apparatus for drilling and coring wells including a plurality of concentric pipes, the inner pipe being the cutter carrier barrel.

J. V. Pennington. U.S.P. 2,068,762, 26.1.37. Core drill.

J. M. Thomas. U.S.P. 2,068,965, 26.1.37. A thief hatch for liquid holding tanks.

J. I. Seay. U.S.P. 2,069,482, 2.2.37. A well-boring tool having expandible reamer blades with means for permitting lateral flow of liquid from the peripherally outer ends of the blades.

D. H. Reed. U.S.P. 2,069,593, 2.2.37. An outside pipe cutter operated by the rotation of a mandrel in contact with the cutters, rotation being obtained by a vertical movement of the mandrel.

M. G. Earley. U.S.P. 2,069,603, 2.2.37. An apparatus for straightening well bores consisting of a number of tiltable interfitting members so arranged that rotation is transmitted to each of the members by means of liquid pressure.

O. Watson. U.S.P. 2,069,792 and 2,069,793, 9.2.37. Liquid gauge rod for measuring stored liquids.

J. A. Zublin. U.S.P. 2,069,795, 9.2.37. A cutter for oil-well tools comprising a wheel-like carrier with a number of cutters rotatably mounted in the carrier, one group of cutters being mounted to rotate about similar axes relative to the carrier axis and another group to rotate at a different angle to the carrier axis.

J. A. Zublin. U.S.P. 2,069,796, 9.2.37. A reaming tool having a number of cutter carriers rotatably mounted in the body in longitudinally spaced positions with a number of cutters mounted in the carriers.

J. A. Zublin. U.S.P. 2,069,797, 9.2.37. Core drill.

J. A. Zublin. U.S.P. 2,069,798, 9.2.37. Rock drilling bit.

J. A. Zublin. U.S.P. 2,069,799, 9.2.37. Drilling bit with roller cutters.

H. L. Laughinghouse. U.S.P. 2,070,135, 9.2.37. A method of reconnecting in a well a severed pump rod normally operating a pump-plunger without removing the plunger and its attached broken section from the well by means of a grappling coupling.

H. E. Hough. U.S.P. 2,070,303, 9.2.37. Apparatus for cementing wells.

G. A. Macready. U.S.P. 2,070,836, 16.2.37. A method of obtaining samples from wells consisting of inserting a tube into the well, temporarily sealing the tubing against the wall of the well to exclude fluid above the seal, causing a sample of the fluid, from below the seal, to enter the tube; breaking the seal and supplying a measured quantity of liquid sufficient to force the sample to the surface for inspection.

L. S. Sorensen. U.S.P. 2,070,869, 16.2.37. A combination over-shot and rotary socket.

H. L. Laughinghouse. U.S.P. 2,070,907, 16.2.37. A tubing bleeder.

E. McDermott. U.S.P. 2,070,912, 16.2.37. A method of electrically exploring a bore-hole by raising the bit a predetermined distance above the bottom of the hole and lowering through the drill pipe an electrode insulated from the drill pipe. The electrode is connected to a battery and recording apparatus and change of voltage and current is noted as the position of the electrode is changed in the hole.

E. Burns. U.S.P. 2,071,197, 16.2.37. Blow-out preventer.

E. V. Crowell. U.S.P. 2,071,389, 2,071,390, 2,071,391 and 2,071,392, 23.2.37. Apparatus and method for cementing wells.

A. C. Catland. U.S.P. 2,071,611, 23.2.37. Well reamer.

J. F. Bozeman. U.S.P. 2,071,916, 23.2.37. Wire line rotary core drill whereby core barrel may be removed during drilling. L. V. W. C.

Production.

451. Volumes and Characteristics of Gas-Cap Material from Kettleman Hills. B. H. Sage and W. N. Lacey. *Calif. Oil World*, 19.11.36, **29** (18), 8.—Investigations of hydrocarbon reserves and of the relative merits of various methods of producing oil and gas require a knowledge of the properties of the materials involved as they exist underground. In fields characterized by the presence of gas caps, the properties of the material occupying that portion of the sands are of interest particularly in those cases where high pressures and temperatures prevail. In these latter cases the material which is gaseous under the conditions in the formation may be expected to separate into gas and liquid phases when brought to surface-trap conditions of temperature and pressure, and probably in the flow string itself.

It was the purpose of the investigation dealt with in this article to study the properties of mixtures resulting from the re-combination in varying proportions of samples of gas and liquid material obtained from the trap. Only one mixture—that having the same proportion of gas and liquid as was being produced in the trap—would be strictly characteristic of the well production. This mixture, in turn, might not be of exactly the same composition as the material in the gas cap, but the purpose of the study was more to learn the behaviour of such materials than to obtain specific information concerning the one well or field from which the samples originated.

Results are given of the investigation carried out on samples under different pressure and temperature combinations. W. W.

452. Acidizing Wells for Production. M. C. Thurber. *Calif. Oil World*, 24.9.36, **29** (10), 14.—A short article on the early experiments carried out in U.S.A., and then dealing with the various methods at present in use and treatments to give the best results. Muriatic or commercial hydrochloric acid is used for well treatment. It has a very small percentage of impurities, the chief one being sulphuric acid. This should not exceed 1%, because it is detrimental to successful acid treatment of lime-containing formations. The most widely used method is to put the acid under pressure and force it into the formation. A light, clean oil that will not tend to clog the formation makes the best load. It is usual to pump the acid from the tank-truck directly into the well, and then pump the oil load through the same equipment. The well is closed, and the added pressure built up by the carbon dioxide gas produced by the action of the acid helps to force the acid farther into the formation. It also has a stirring effect on the solution. A 1000-gallon treatment of 15% acid will dissolve approximately 10 cu. ft. of limestone. The usual procedure is to use only a part of the total amount of acid at one time, and to make two or three successive treatments, the hole being cleaned out between each treatment. W. W.

453. Use and Method of Operation of Formation Testers. Anon. *Calif. Oil World*, 26.11.36, **29** (19), 8.—Deals with the general operation and action of the formation

tester, and the recommended practices to be observed for obtaining the best results in the application of the testing tool for rat-hole testing, straight or open-hole testing and casing-shoe testing. W. W.

454. Depthograph. C. P. Walker. *Calif. Oil World*, 15.10.36, **29** (13), 8.—Describes a new instrument for the production engineer for use in determining the fluid levels in oil wells. The apparatus records pressure wave echoes—produced by releasing compressed gas into the casing—and determines the velocities at which the waves travel. W. W.

455. Solvents Aid in Solving Paraffin Problems. J. Chastain. *Oil Weekly*, 8.2.37, **84** (9), 38.—The deposition of paraffin in the tubing of pumping wells in the Oklahoma City field has caused serious trouble. Daily production falls as the first indication of paraffin, and much trouble to sucker-rods results from an increase of stress beyond the yield point. It has been found to increase as much as 2000 or 3000 lb. per sq. in. in three weeks of paraffin deposition, and at this point production had fallen off as much as 20 brls. a day.

Several companies have chosen to make a paraffin solvent which takes less volume and does as much, if not more, good, and claims to cause less shut-down time and trouble while making the treatment. L. V. W. C.

456. Percentages of Recovery. V. G. Gabriel. *Oil Weekly*, 1.2.37, **84** (8), 35.—The determination of the percentage of the recovery of oil from oil pools is complicated by a number of factors which greatly influence the final determination. Even in the ideal case the determination of the average porosity and thickness usually gives some difficulty. The author has given tables showing the variations in the acre-foot content of oil as a function of porosity and saturation. L. V. W. C.

457. Water-Flood Operation. F. B. Taylor. *Oil Weekly*, 1.2.37, **84** (8), 28.—A constant control of the level of the treated water in the output tanks is an aid in water-flood operation. One company operating a water-flood project in the Nowater, Oklahoma, area has equipped these tanks with a butterfly valve working against the pressure of the water column in the accelerator tank. By controlling at the treated water tank and discharging from the accelerator overflow into the make-up basin, treated water is only passed once through the filter unit. L. V. W. C.

458. Pressure Restoration in the Oilfields of Poland. H. Gorka. *Oil Weekly*, 22.2.37, **84** (11), 188.—The Marietta method of injecting a gas medium into oil beds has been put into practice in the oilfields of Poland. Complicated geological structure may be attributed to the results not always being successful. L. V. W. C.

459. Secondary Recovery Methods Used to Revive Bellevue Pool. M. Tucker. *Oil & Gas J.*, 28.1.37, **35** (37), 172.—The Bellevue pool of northern Louisiana has been brought into a strong position by means of closer well spacing and secondary recovery methods. Experimental work has been carried out on water-flooding, steam injection, closer spacing and repressuring, all of which have shown their worth in increasing daily production and adding to the ultimate yield of the heavily saturated sand. L. V. W. C.

460. World's Deepest Oil Producer Completed in Ventura Avenue. T. P. Sanders. *Oil & Gas J.*, 4.2.37, **35** (38), 33.—The world's deepest producer has just been completed in the Ventura Avenue field. The well is 10,569 ft. deep, and during the first 23 hours it flowed 533 brls. of 30·3 gravity oil with 430,000 ft. of gas. The tubing pressure was between 20 and 30 lb. and the casing pressure was 500 lb. L. V. W. C.

461. Oil Well Behaviour based upon Subsurface Pressure Data. H. C. Miller, E. S. Burnett and R. V. Higgins. *Oil & Gas J.*, 28.2.37, **35** (41), 69.—The authors have

summarized the results obtained in a Bureau of Mines study of certain data pertaining to subsurface pressures and production of wells producing oil and gas and water. A simple relation has been found between the mass rate of fluid production and the corresponding drop in pressure in the reservoir sand for wells flowing naturally under volumetric and hydraulic control. The equation, $M = C(P_f - P_s)$, when M is the mass rate of fluid production, pound per 24 hours, C is a coefficient, P_f is the average shut-in formation pressure opposite the mud and P_s is the average back pressure, is an expression of the ability of a well to produce and permits comparison on a uniform basis of the productivities of different wells. The mass rate of production is a straight-line function of the drop in pressure through the sand. L. V. W. C.

462. Fitts Field Development a Composite Scene of Controlled Operations. F. B. Taylor. *Oil Weekly*, 8.3.37, **84** (13), 21.—The discovery and development of Fitts pool has been instrumental in aiding the industry in two important respects. The first is the disproval of the opinion that there was no retention of accumulation due to extreme faulting. This fact will mean more tests for a number of areas similarly faulted. The second influence has been the adoption of methods new to Mid-Continent practice. In production the lime strata have been treated with exceedingly high volumes of acid, in some cases at intervals to establish a new technique.

Due to the number of horizons, strata have been grouped for production control. This practice will greatly aid in sustaining reservoir energy and will probably lead to a relatively high ultimate recovery. L. V. W. C.

463. Production from a Depth of Two Miles. W. A. Sawdon. *Petr. Eng.*, Feb. 1937, **8** (5), 86.—The world's record for deep production has been established in the Ventura field, California. The well is now flowing from a depth of 10,569 ft. This is the first well to produce from a depth of more than two miles. It has also made a definite contribution to straight-hole drilling practice, for one of its outstanding features is its close limits of vertical deviation. L. V. W. C.

464. Proper Gas–Oil Ratio Factor in Allocating Production. M. Tucker. *Oil & Gas J.*, 18.2.37, **35** (40), 27.—The Rodessa field has shown how the injection of a proper gas–oil ratio factor in the allocation of production will result in conservation of natural gas and reservoir energy. The field allowable is allocated upon a 50% acreage and 50% bottom-hole pressure basis, with a gas limit factor of 2000 ft. of gas to 1 brl. of oil. By this means the gas withdrawal has been reduced about 90% and the wastage to practically nothing. L. V. W. C.

465. Plugback Work in East Texas Increased by New Cements. M. Tucker. *Oil & Gas J.*, 18.2.37, **35** (40), 51.—Plugback jobs in the East Texas field for the purpose of shutting off bottom-hole water have been successfully carried out by the use of the newer type cements particularly suitable to this work. These cements have a high degree of grain fineness, and a gel-like consistency and will not separate out from their water. A retarded setting action is afforded to permit longer pumping times, with greater pump ability, at higher pressures, and a deeper channelling or penetration of the cement into the formation is assured. A slurry of from 14 to 16 lb. per gallon is pumpable with these cements without sacrifice of other desirable properties and the contamination with either mud or water is negligible. L. V. W. C.

466. Crude Emulsions in Talco Pool Present Treating Problems. M. Tucker. *Oil & Gas J.*, 11.2.37, **35** (39), 62.—The emulsions of the Talco pool present one of the most troublesome treating problems of recent years. Electrical dehydration has proved the most effective method of economically handling this emulsion.

The emulsifying agent has been difficult to determine definitely, and only in a few instances have most of the forms of chemical treatment been successful in effecting a complete separation.

In all cases the " flow line " method of dehydration is used with the electrical units, the oil being run direct from the well through the dehydrator and then into the dry oil stock tanks. L. V. W. C.

467. Use of Gel Compound Aids in Acidizing Wells. P. E. Fitzgerald and F. R. Holland. *Oil & Gas J.*, 4.2.37, **35** (38), 46.—Control of the treating solutions in acidizing wells is of as much importance as the selection of the proper type of solvent.

In certain wells when the acid was injected it entered the lower sandy members, resulting in a smaller increase in production than would have been obtained had the acid been confined to the sandy lime sections. The solution to this problem appeared to be to plug the lower horizons which could be removed after treatment. After an extensive search an organic jellifying material was produced. This material is capable of setting to a firm gel when mixed with water. It is introduced into a well as a liquid dispersion or solution and becomes a solid or semi-solid jelly after it has reached the bottom of the hole. L. V. W. C.

468. Survey of the Production of Petroleum in Russia. I. Ganitzki. *Mon. Petr. Roum.*, 1937, **38**, 241–243.—The post-war period has seen a vast increase in the use of electricity in the producing industry. Of the power used by the industry in 1920, 24% was from electricity, 54% from steam and 22% from diesel engines; in 1928 electricity supplied more than 91% of the power. In 1932 the two most important trusts—Azneft and Grozneft—used 100% and 98%, respectively. Tables illustrate this growth.

This period has also seen the reorganization of the producing fields. The wasteful tendency to rely on gushers for supplies has been checked, and air-lift and bottom-hole pumping is accounting for an increasing amount of the production. These modern methods have meant a revival for the failing Grozneft fields, which are now able to produce from once-abandoned wells. In the Staro Groznyi region, in 1932, a well with a daily production of 0·5 to 3 tonnes was considered a commercial proposition. The Grozneft revival owes a great deal to the new Malgobec field, where 215 wells are each averaging 19 tonnes a day, and to the new Daghestan fields, from which one million tonnes are expected in 1937. Tables show the failing Grozneft production and the development of the reviving factors.

There has, in the last three years, been a definite reorganization of production. That the U.S.S.R. are taking full advantage of air-lift and bottom-hole pumping is shown by the fact that the 1937 programme foresees the restarting of 2000 abandoned wells. A series of measures reorganizing production were decreed in September 1936, and are given in the article. T. C. G. T.

469. Influence of Production Practices on Gravity. R. R. Boyd. *Oil & Gas J.*, 14.1.37, **35** (35), 50.—Methods of production result in changes in gravity either within the reservoir or in the wells, lines and traps. Migration may cause gravity changes within the reservoir, gas liberation in the reservoir has a bearing on the gravity of the oil entering the well, and an increase in casinghead gasoline from the well must result in the lowering of the gravity of the oil produced. Curves are given showing the effect of substituting wet gas circulation for dry gas in gaslift operations and the effect of producing wells with periodic intervals of idleness. L. V. W. C.

470. Hendricks Wells Pump 99 per cent. Water and Show Profit. T. P. Sanders. *Oil & Gas J.*, 14.1.37, **35** (35), 48.—Wells in the Hendricks pool of Winkler County, Texas, are producing fluid of which less than 1% is oil, and yet profit is obtained from operating these wells. From one well 11,500 brls. of fluid were pumped per day and only 14 brls. of this total were oil. An exceptionally high fluid level makes it possible to handle large volumes of water profitably. Casing pumps are installed in the wells without tubing. They can either be plunger pumps or cup pumps. The pumps are encased in a shell and lowered into the wells on the sucker rods to be used for pumping. L. V. W. C.

471. Salt Water Disposal is Serious Problem in Michigan Fields. T. P. Sanders. *Oil & Gas J.*, 7.1.37, **35** (34), 47.—The disposal of salt water produced with the oil in the Michigan Fields is such a problem that it is possible that many of the wells will have to shut down as the only alternative to incurring heavy expenditures for such disposal. Wells are being deepened and left uncased in order that the porous formations may

take large quantities of brine. Acid treatment is to be used to try to increase the capacity of the strata. L. V. W. C.

472. Old Wells are Limited by Natural Conditions Revealed by Oil Mines. L. G. E. Bignell. *Oil & Gas J.*, 21.1.37, **35** (36), 37.—Owners of stripper wells are resorting to many means to increase production. Secondary methods of recovery have been applied because the formations have been depleted of the natural energy, and mechanical means to drive the oil to the wells must be used. Where there is an absence of water drive, water is forced into input wells, or gas or air may be forced into the producing sands to drive the oil ahead. Without artificial aid these wells will produce very small quantities but the walls of the well having been coated with a waxy precipitate it is necessary to use some method to remove this coating, but even then the increase in production is not appreciable. An explanation of this trouble is found in the experiences of oil mining. Conditions have been observed in these mines.

L. V. W. C.

473. Methods of Establishing Well Potentials. S. F. Shaw. *Oil Weekly*, 8.2.37, **84** (9), 26.—Proration has brought about a need for establishing well potentials on which to base proration figures. A number of methods are available, but the open-flow potential has advantages of containing greater elements of fairness, of satisfying the majority of operators and of being easier to take. This method is based usually on a 24-hour production test, but where the quantity produced is very large, enormous tankage capacity is required to contain the production of a single day's run. In such a case the test is made over a smaller period, and the quantity is multiplied by the proper ratio to arrive at the 24-hour potential.

Methods based on potentials other than those established by producing wells at maximum capacity are not likely to be equitable methods. If sufficient care is taken, potentials based on pressure observations can be made fairly dependable. The open-flow potential seems to contain greater elements of fairness as between individual wells than other methods. L. V. W. C.

474. Corrosion of Steel by Oil Well Waste Waters. W. F. Rogers and W. A. Shellshear. *J.I.E.C.*, 1937, **29** (2), 160.—The conditions governing the corrosion of steel by waste waters are studied, particularly with regard to variations in concentrations of hydrogen ions, soluble salts, hydrogen sulphide, oxygen as well as variations in water–oil ratios. The main conclusion arrived at is that increasing concentration of dissolved oxygen increases the degree of corrosion, and that this is the deciding factor. Under oxygen-free conditions, oil well waste waters of *p*H 6·6–8·0 are non-corrosive regardless of the soluble salt or hydrogen sulphide content. The presence of oil to the extent of 30% or above greatly reduces the rate of corrosion in the presence of oxygenated waters.

H. C. R.

Transport and Storage.

475. More about Pipe-line Corrosion. S. Ewing. *Oil News*, 1936, **40**, 250–252.—Article adapted from a paper presented at a meeting of the American Gas Association. The paper deals with the report of the sub-committee on pipe coatings and corrosion of the American Gas Association on the examination during the summer of 1935 of the third set of coated pipe specimens which were buried in 1929. The research associate spent a period of approximately four months on the field, during which time fourteen sets of coated pipes were removed and tested and thirteen companies were visited. The report is a discussion of some of the observations made on the trip. Of the new coatings examined it was found that the unreinforced asphalt coating is more resistant to moisture absorption, and is also more stable chemically than the rag-felt reinforced coating which was previously used.

The Cellophane and Kodapak reinforcing materials seem to serve every purpose that the felt serves, and they have the advantage that they do not absorb as much moisture and they are cheaper. These two coatings were inspected in several places, and their appearance was certainly impressive. The observations made during the trip indicate clearly that there is a serious attempt on the part of the gas companies to take advantage of all that is known about coatings and corrosion. W. W.

Gas.

476. Natural Gasoline. Anon. *Refiner*, 1937, **16** (1), 22–32.—Noteworthy accomplishments during 1936 in the natural gas industry are summarized under construction, engineering and design, technical development, gas polymerization, measurement and regulation and carbon black. G. R. N.

477. Gas Compression Variables. Calif. Nat. Gas Assn. *Calif. Oil World*, 5.11.36, **29** (16), 9.—The Gas Engine and Compressor Committee, appointed by the California Natural Gas Association, has carried out tests on gas compressors with the object of formulating technical data on the variables and the power relationship of a gas compressor, and the results obtained to date of issue of this article are briefly discussed. The work included sixty-eight runs, wherein every conceivable variable was introduced, except the influence of different valve design, the supercompressibility effect at pressures above 300 lb./sq. in., and the influence of the composition of the gas being compressed. The committee contends that the solution of the problems concerned with supercompressibility and gas composition are very closely related, and will only be solved when more information is available on the subject than at present. W. W.

478. Gas Flow in Pressure Pipe-lines. T. W. Johnson and W. B. Berwald. *Oil News*, 1936, **40**, 237–238.—Short article adapted from Monograph 6 of the United States Bureau of Mines. This monograph presents the results of a study of the flow of natural gas through high-pressure transmission lines. In initiating the study discussed in this bulletin, a review and compilation were made of the published data and formulæ for determining the flow of natural gas through pipe-lines. Many formulæ are given in the literature, and the results using the different formulæ vary widely. The basic differences between these formulæ are explained in the derivation of the general flow formula and by the methods of considering the coefficient of friction. W. W.

479. Mathematical Analysis of Absorbers. A. J. L. Hutchinson. *Refiner*, 1936, **15** (12), 578–579.—A short mathematical treatment is given of the plate by plate absorption of gasoline from gas, assuming that the rate of change of liquid mols. flowing down the absorber is the same for every plate and that the same law of rate of change of the number of gas mols. holds. G. R. N.

480. Patents on Gas. Sulfur-Chemie A.-G. E.P. 459,418, 7.1.37. Desulphurization of gases by imparting an intense mechanical movement to a solution of a thiosulphate and introducing the gases into the solution. The thiosulphate content is reduced to a predetermined degree and the gases are then freed from H_2S and SO_2 by treatment with this activated solution.

I.G. Co. E.P. 459,471, 8.1.37. Separation of hydrocarbons which are liquid at room temperature from gases containing them by passing the gases at 250–600° C. in the presence of oxygen and steam if desired over a nickel catalyst.

C. Padovani. E.P. 460,801, 4.2.37. Gasification of mineral oils to obtain permanent combustible gases by passing the vapours over a porous catalyst, *e.g.* activated carbon or silica gel containing Mn, Ni, Co, etc., at 600–1000° C.

H. R. Staltz. U.S.P. 2,068,091, 19.1.37. Method of recirculating flue gases.

C. C. Miller. U.S.P. 2,069,172, 26.1.37. Separation of normally gaseous unsaturated hydrocarbons from normally gaseous hydrocarbons by liquefying the mixture, maintaining in the liquid form and extracting it with an aliphatic alcohol containing about 10% of water, phenol or cresol.

C. C. Miller. U.S.P. 2,069,173, 26.1.37. Separation of normally gaseous unsaturated hydrocarbons from normally gaseous hydrocarbons as described above by liquefying the mixture at −60° F. and extracting it with SO_2. W. S. E. C.

Crude Petroleum.

481. Properties of Crudes Produced Outside of the U.S. G. Egloff. *Oil & Gas J.*, 28.1.37, **35** (37), 183.—Analyses and properties of representative crude oils produced in Iraq, China and Italy are tabulated. Yields of gasoline, kerosine and residuum obtainable are given together with the properties of these fractions. Refining capacity in Iraq amounts to 2500 brls. per day and in Italy 34,000 brls. a day, plus a cracking capacity of 10,900 brls. a day. R. A. E.

482. Crude Oil Stabilizer at Kirkuk. Anon. *Petr. Times*, 6.2.37, **37** (943), 173.—The Iraq Petroleum Co. has installed a plant to stabilize the whole of the field's output of approx. 80,000 brls. per day. Light gases and H_2S are removed in the one process and, since the H_2S content is high, efficient fractionation is the keynote of the plant. The process is in two stages. The first secures the elimination of undesirable constituents, effects a light topping of the crude and a partial fractionation of the distillate. The second stage fractionates this distillate and the vent gas from the first stage. The topped crude from the first stage is blended with the stabilized distillate to produce the stabilized crude. The plant is described and illustrated in detail. H. G.

483. Methods for Handling the Increasing Salt Content of E. Texas Crude. A. L. Foster. *Nat. Petr. News*, 24.2.37, **29** (8), 96.—Difficulties due to corrosion and the deposition of salt from salt-bearing crudes is being combated by the removal of the salt. From 3 to 5% of water is injected into the crude oil, which is then heated to 220–240° F. and passed to a settling drum. Adequate pressure, up to 200 lb. per sq. in., is maintained on the latter to prevent the loss of light fractions. Under these conditions the minimum settling time is 50 minutes. In some cases the settling drum is connected to a small fractionating tower and the process carried out at ordinary pressure. By such means the salt concentration is reduced from 150 to 5 lb. per barrel. H. G.

484. Desalted Crude Reduces Corrosion. J. C. Albright. *Nat. Petr. News*, 6.1.37, **29** (1), 61.—The crude produced from certain acidized wells contains water-soluble salts in the following quantities per 1000 barrels. $CaCl_2$, 28 lb.; $MgCl_2$, 3 lb.; $FeCl_2$, 11 lb.; NaCl, 66 lb. On extracting the crude with ten times its volume of water the aqueous extract showed a *p*H value of 4·0. The crude is desalted by passage, at 125–150° F., through electrostatic separators. The crude is "emulsified" with one-third its volume of water and atomized over two units of concentric rings maintaining an electrostatic field equivalent to 33,000 volts. Anhydrous NH_3 is introduced into the cracking unit to neutralize free HCl. The rest of the article concerns itself with a consideration of details of the cracking plant and equipment. H. G.

485. Equipment for Treating Oil is Adapted to Recovery of Oil. L. G. E. Bignell. *Oil & Gas J.*, 17.12.36, **35** (31), 37.—A plant for separating oil from oil sand, having a capacity of 250 tons of sand per day, was installed and put in operation near Mt. Murray, Alberta, Canada, early in September. The process has been developed by J. M. McClane. The film of oil, which forms around each sand grain and acts as cementing material, is warmed in a body of warm, slightly alkaline water, by agitation in a pug-mill. The water is at a temperature of 180–200° F. and contains about 0·1% of sodium silicate. The oil particles are floated out of the pulp in a quiet-zone flotation cell, a special feature of the plant, which facilitates separation of sand from the recovered oil. The oil, with some sand and water, is then skimmed from the surface of the water by a roller. This recovered material is then diluted with kerosine or naphtha, using a vertical feed pipe containing a revolving blade-shaft, followed by a sand pump, which mixes the materials without emulsification. The mixture passes to a special settling tank in which the sand and water settle to the bottom. The sand is then passed to the outlet by means of a shaft fitted with blades placed in the bottom of the tank. Water is drawn off through a tap 6 in. above the bottom of the tank and oil by means of a pipe near the top of the tank. The sand is dewatered and discharged as waste. It contains less than 0·5% of oil. The oil sands treated contained about 14·7 by vol. of oil, and the oil recovered amounted to 12·5% of the

treated sand. The cleaned oil contains 1 to 1½% of water and about ½% of mineral matter, which is mainly fine clay and has no abrasive effect.

The possibility of using a similar type of plant for recovering oil from underground sands in the oilfields, using recovered sand as back fill, is mentioned. R. A. E.

Cracking.

486. Nitrogen Bases from California Cracked Gasoline. A. C. Bratton and J. R. Bailey. *J.A.C.S.*, 1937, **59**, 175–177.—The crude bases for this investigation, b.p. 115–240° C., were extracted from four barrels of pressure distillate, b.p. 36–171° C., obtained in cracking gas oil from Los Angeles Basin petroleum and crude residuum from San Joaquin Valley petroleum. The cracking operation was at 454° C. and at 54/58 atmospheres.

Nine bases consisting of quinoline, quinaldine and seven pyridine homologues were isolated. The latter were 2-methyl, 4-methyl, 2 : 6-dimethyl, 2 : 5-dimethyl, 2 : 4-dimethyl, 3 : 5-dimethyl and 2 : 4 : 6-trimethyl. In contrast to straight-run distillates in the same temperature range, which contain in preponderant amount non-aromatic bases, only aromatic bases were encountered in the cracked gasoline. At the temperature of the cracking plant, non-aromatic bases are evidently unstable and, maybe, undergo dehydrogenation and molecular rearrangement to more stable aromatic types. W. E. J. B.

487. Cracking and Polymerization Practice. Anon. *Refiner*, 1936, **15** (12), 537–543.—The combination cracking and polymerization unit of the Atlas Oil Corporation at Shreveport is described. This consists of two Gyro units charging daily 5600 brls. East Texas topped crude, the cracked gases from these units being polymerized in a Pure Oil Thermal Polymerization unit. The blended cracked and polymerized gasoline is clay treated, then re-run, and has an octane number of 71 (C.F.R. Motor Method). The sequence of the numerous operations involved is given. G. R. N.

488. Freedom Cracking Unit. J. C. Albright. *Refiner*, 1937, **16** (1), 33–35.—The 500-brl. Dubbs unit of the Freedom Oil Co. was built very compactly owing to space being at a premium. It has a two-cell furnace with top-fired burners. The cracking coil in part acts as a conversion coil, so no reaction chamber is necessary. The unit has only one tower combining the functions of a flash chamber and a dephlegmator. The charge to the unit is gas oil, foots oil, petrolatum or admixtures of these products. The cracked gases are passed through a vapour recovery unit in which the gas oil is used as absorption oil. The yield of 400° F. end-point gasoline obtained averages 69–72% according to the stock. Details are given of some of the methods employed to make the maximum use of the space available. G. R. N.

489. The Fushun Dubbs Cracking Unit. R. Ohashi. *J. Fuel Soc. Japan*, 1936, **15** (171), 105–107.—This unit has a daily capacity of 850 brls. and is designed to crack shale oil having the following characteristics: Sp. gr./10° C. 0·895, I.B.P./F.B.P. 116–391° C. with 50% at 340° C., 18·4% paraffin and Redwood viscosity at 50° C. of 56·8 seconds. A two-coil furnace is used with continuous coking operation, effected by alternation of the coking chambers. Special anti-corrosive alloys are used in all important parts of the unit, whilst a special temperature controlling system is adopted to avoid coke deposit. The average yield of 210° C. end-point raw gasoline was 62% for a 17-day run. This gasoline had a sp. gr. at 60° F. of 0·746 and an octane number of 62. G. R. N.

490. Cracking of Paraffin Oil on Glowing Graphite. K. Peters and K. Winzer. *Brennstoff-Chemie*, 1936, 17, 429–430.—Pointing out that in their earlier experiments using glowing platinum wire, by reason of the deposition of a skin of graphite on the surface of the platinum, the cracking actually occurred on a glowing graphite surface, experiments have been carried out using glowing graphite rods. The ratio of gaseous to liquid products and the composition of the cracked gas were similar to those obtained with the platinum wire, but a smaller conversion per kWh. is ascribed to the shorter length of graphite rod as compared with the wire, this leading to a proportionately greater loss of heat by conduction to the lead in.

Electrically heated graphite rods are concluded to be eminently suitable for the thermal cracking of hydrocarbon oils. B. C. A.

491. Russian Oil Industry. Cracking, etc. I. Ganitzki. *Mon. Petr. Roum.*, 1937, **38**, 163–167.—A table gives the amount of (*a*) petrol and petroleum ether, (*b*) kerosine, and (*c*) crude oil treated for the years 1932–36. Over this period: (*a*) rose from 2,881,000 metric tons to 3,920,000 metric tons, (*b*) rose from 4,203,000 metric tons to 5,560,000 metric tons, and (*c*) rose from 20,215,000 to 25,100,000 metric tons.

The percentage of petrol rose from 14·1 to 15·6%. It was only 3·9% in 1913. The rise was due in part to the high quality of the Groznyi field and in part to cracking.

Internal consumption of petrol rose from 895,000 metric tons in 1932 to 3,500,000 in 1936. Export fell from two million metric tons in 1932 to 420,000 metric tons in 1936.

Of the 3,920,000 metric tons of (*a*) above, 1700 were obtained by cracking or from gas.

A contract for cracking plant was given to Vickers in 1925, but it is stated that this firm had not previously had experience in this direction, and after three years the Soviet engineers modified the plant. The first plant came into production at the end of 1929, and had an annual capacity of 60,000 metric tons. Others were added quickly, and by the end of 1931 there were working 4 modified Vickers, 8 Jenkins, 11 Winkler-Koch and 1 Russian patent plants. The first two were expensive, and the W-K plant gave a petrol with an octane number of 60–65.

Russian plant was introduced in 1931 with sufficient capacity to treat 150,000 metric tons per annum. Plans for 1933–37 allowed for 85 of these plants in various districts, but bigger units treating 250,000 metric tons were introduced in 1935. In 1936 34 new units came into production, making a total of 58 working, with a capacity of 9,150,000 metric tons crude. Twenty-three out of the first 24 units were in the Caucasus, most of the later ones being elsewhere. It is estimated that 90% of the programme will be achieved by the end of 1937. W. E. J. B.

492. Patents on Cracking. J. G. Alther. U.S.P. 2,066,664, 5.1.37. Improved furnace for cracking plants.

P. H. Sullivan. U.S.P. 2,066,808, 5.1.37. Vapour and liquid-phase cracking in which the vapours from both stages are blended so as to minimize the formation of asphaltenes or tar-like substances.

J. H. Lawrence. U.S.P. 2,067,056, 5.1.37. Oil-still for cracking operations.

R. H. Price and R. V. Shankland. U.S.P. 2,067,730, 12.1.37. Cracking of hydrocarbons in three stages.

E. F. Nelson. U.S.P. 2,067,782, 12.1.37. Cracking of hydrocarbon oil and natural gas.

C. H. Angell. U.S.P. 2,067,810, 12.1.37. Production of light oil and coke from heavy hydrocarbon oil and coke.

N. W. Stirling. U.S.P. 2,067,864, 12.1.37. Fluid heater control for cracking plants.

R. M. Parsons. U.S.P. 2,068,695, 26.1.37. Remote safety control system for oil-cracking plants.

R. M. Parsons. U.S.P. 2,068,696, 26.1.37. Gauge-line purging system for oil-cracking plants.

F. A. Howard. U.S.P. 2,068,856, 26.1.37. Combined still and coil-cracking plant.

C. P. Dubbs. U.S.P. 2,069,358, 2.2.37. Cracking of hydrocarbons to produce maximum yields of gas.

C. H. Angell. U.S.P. 2,070,249, 9.2.37. Simultaneous topping, cracking and reforming of hydrocarbon oils of relatively wide boiling range.

J. D. Seguy. U.S.P. 2,069,392, 2.2.37. Vapour-phase cracking of hydrocarbon oils. W. S. E. C.

Hydrogenation.

493. Production of Gasoline and Lubricating Oils from Wood, Tar and Shale Oil by Hydrogenation. H. Bergström, K. N. Cederquist and K. G. Trobeck. *Iva*, 1937, **1**, 15–29.—Continuation of the work described in abstract 89. The catalyst, $(NH_4)_2MoS_4$, was prepared by passing H_2S through an ammoniacal solution of $(NH_4)_2MoO_4$, the resulting precipitate being dried and pulverized. The work with this catalyst was divided into six parts:

(1) Production of lubricating oils from wood tar. An autoclave was charged with 20 kg. wood tar and 1 kg. catalyst, together with H_2, the initial pressure being 80 atm. The temperature was slowly raised to 350° C., where it was maintained for 5½ hours, when no more H_2 was consumed. The H_2 pressure at that temperature was maintained throughout approximately constant at 192–200 kg./sq. cm. On cooling to room temperature, the pressure dropped to 46 atm. The H_2 consumption amounted to 3·5 wt.-% of the wood tar. The catalyst lost 39·8% of its S content, the greater part of which left the autoclave with the gases formed, the oils themselves being low in S. The following yields were obtained: 12·3% gasoline with E.P. 220° C. and sp. gr. 0·7735, 57·1% lubricating oils, 10·6% heavy oils not suitable as lubricants, the remainder being gases, water, solid residue in the autoclave and losses. The lubricating oil was redistilled under vacuum in seventeen fractions, the sixteenth one, 6·6% of the charge, boiling between 215° C. at 11 mm. Hg and 216° C. at 12 mm. Hg, having a sp. gr. of 0·9503, a flash point 157° C., and viscosities 9·43 and 2·20 Engler at 20° C. and 50° C.

(2) Production of gasoline from wood tar. In order to avoid water formation, hydrogenation was carried out in steps, the first one at 350° C., the last one at 450° C. The autoclave was cooled and the low-boiling fractions distilled off between each step. The autoclave was charged with 20 kg. tar and 1 kg. catalyst, H_2 being added until 80 atm. In the first step the temperature was raised to 350° C., the pressure being 180 atm. Much water and only small amounts of hydrocarbons were formed. In the second step, the temperature was raised to 375° C. Less water and more hydrocarbons were obtained, but some of the latter could not be condensed. The third and fourth steps were carried out at 425° C. and 450° C., very little water and considerably more hydrocarbons being formed. The wood tar was the same as that used before in (1), and consumed 6·65 wt.-% H_2. Yields were 54·4% gasoline of E.P. 220° C. and sp. gr. 0·7978, 25·5% light oil boiling above 220° C., 12·9% water, 11·6% gases, the remainder being solid residue and losses. It is believed that the gasoline yield can be raised to 80–85% in an apparatus allowing the removal of light hydrocarbons as soon as formed.

(3) Production of lubricating oils from shale oil. The shale oil used (C = 84·0%, H = 9·51%, S = 1·93%) was taken from Kinnekulle. The autoclave was charged as before, and hydrogenation carried out at 350° C. and 200 atm. The reaction was slower than with wood tar. The H_2 consumption was 2·36 wt.-% and the yields 2·6% gases, 24·6% gasoline of E.P. 220° C. and sp. gr. 0·7930, and 70% oils, boiling above 220° C., with sp. gr. 0·9320, S content 0·31%, and viscosities 3·6 and 1·6 Engler at 20° C. and 50° C. respectively. This oil was fractionated into 15 cuts. The twelfth cut, 4·57% of the charge, boiling between 209° C. at 3·5 mm. Hg and 224° C. at 6 mm. Hg, had a sp. gr. of 0·98, flash point 195° C., viscosities 10·1 and 1·7 Engler at 50° C. and 100° C.

(4) Production of gasoline from shale oil. Materials and charges were as before, but shale oil, in addition to H_2, was added continuously. Temperature and pressure were about 450° C. and 150 atm., and the time was about 48 hours. The H_2 consumption was 3·6 wt.-% and yields 4% gases, 3% water, and 83·6% oils. On redistillation the oil yielded 48% gasoline of E.P. 210° C. and sp. gr. 0·7914, and 49·6% oil boiling above 210° C. of sp. gr. 0·923. This oil was fractionated into 11 cuts, the tenth one, 6·67% of the charge, boiling between 194° C. and 230° C. at 6 mm. Hg, having a sp. gr. 1·005, flash point 159° C. and viscosities 10·9 and 2·4 Engler at 20° C. and 50° C.

(5) Production of lubricating oils from Rosin Beck. This material when hydrogenated at 350° C. yielded an oil of which only a small fraction was suitable for lubricating purposes.

(6) Production of gasoline from liquid rosin. The material consisted of 53% fatty acids and 40% resinous acids and was treated as described in (2). The tempera-

ture in the first step was 350° C., second 425° C. and third 450° C. As before, much water was formed in the first step, most of the hydrocarbons being obtained in the second and third steps. H_2 consumption was 5 wt.-% and the yields 12·8% water, 15% gases, and 63% oil boiling below 220° C. When the latter was fractionated 87% distilled at 220° C. This redistilled gasoline had a sp. gr. of 0·7462. In this case, too, it is believed that the gasoline yield was reduced by cracking. R. F. S.

494. Hydrogenation Tests on Canadian Coal. T. E. Warren and R. E. Gilmore. *Ind. Eng. Chem.*, 1937, **29** (3), 353.—This paper records the results obtained by the hydrogenation of a typical bituminous coal from eastern Canada.

A complete description of the equipment used in these tests is given, together with full details of the method of operation.

The experimental conditions were, operating pressure 3000 lb. per sq. in., temperature 450° C., rate of charging of oil–coal paste 9 lb. per ton, and rate of gas recirculation 5 cu. ft. per hour.

The catalyst employed was stannous oxide, the amount used being 5% of the coal charged.

Typical results are presented in the following table :—

Operating Conditions and Yields.

Run :	3.	4.	5.	6.	7.	8.
Operating Conditions.						
Temperature, ° F.	829	833	833	831	832	857
Temperature, ° C.	443	445	445	444	444	458
Pressure, lb. per square inch	2940	2430	2940	2940	2940	2940
Rate of charging, lb. of paste per hour	8·83	9·01	9	6·04	8·92	8·70
Rate of discharge of gas, cu. ft. per hour at room temperature and pressure	34·0	38·5	18·8	16·3	0	0
Liquid Product.						
Solids insoluble in CCl_4, %	6·36	5·76	—	3·90	13·6	3·56
Ash in insoluble solids, %	57·9	56·6	—	46·5	49·6	41·9
Distillation of Liquid Product.						
Water	4·85	4·98	—	5·67	4·80	5·55
Oil fraction to 338° F. (170° C.)	4·29	5·88	—	7·26	4·36	6·92
Oil fraction, 338°–446° F. (170–230° C.)	17·0	15·8	—	15·8	11·9	13·6
Oil fraction, 446–572° F. (230–300° C.)	36·4	29·8	—	26·9	29·6	27·9
Residue above 572° F. (300° C.)	37·0	42·6	—	43·3	48·4	45·5
Distillation loss	0·47	0·89	—	1·03	0·92	0·50
Pitch from Reaction Chamber.						
Solids insoluble in CCl_4, %	32·6	30·8	35·3	50·9	33·1	53·6
Ash in insoluble solids, %	52·0	56·4	49·1	40·8	45·8	36·3
Recirculating Gas.						
H_2 after heating to 662° F. (350° C.), %	95·3	97·3	—	96·0	97·4	92·4
H_2 at start of charging, %	93·4	—	98·3	94·9	96·2	92·1
H_2 after 3 hours of charging, %	86·8	—	—	80·9	85·4	80·4
H_2 at end of charging, %	84·5	—	86·7	82·8	78·7	68·2
H_2 after cooling to 662° F. (300° C.), %	84·1	85·1	—	83·5	82·1	65·4
Yields Per Cent. of A.M.F. Coal.						
Hydrogen consumption	8·0	7·1	—	10	6·1	8·3
Nett oil from coal	77·6	72·5	—	53·7	73·0	54·9
Gas plus loss	15·7	23·2	—	32	22·2	31·0
Combustible solid residue	6·3	4·4	—	17·5	3·5	16·6
Water	7·7	7·4	—	8·5	7·3	8·0

H. E. T.

495. Patents on Hydrogenation. J. Y. Johnson. E.P. 459,662, 11.1.37. Improved valve for use in pumping liquids containing solid substances under pressure, *e.g.* coal-oil mixtures.

N. V. de Bataafsche Petr. Mij. E.P. 460,747, 3.2.37. Hydrogenation of unsaturated organic compounds and dehydrogenation of organic oxy-compounds to obtain volatile saturated hydrocarbons and valuable carbonyl compounds of the class consisting of aldehydes and ketones.

N. V. de Bataafsche Petr. Mij. E.P. 460,758, 3.2.37. Production of olefines by catalytic dehydrogenation of paraffin hydrocarbons using as catalyst, activated alumina at 500–800° C.

J. D. Seguy. U.S.P. 2,066,697, 5.1.37. Catalytic hydrogenation of hydrocarbon oils using as catalysts Zn, Sn, Cu, Al, Fe, Ni, Co, Pd, etc., or metal catalysts, *e.g.* Fe coated with Sn as a promoter or a mixture of molybdenum and iron oxides.

A. von Groeling. U.S.P. 2,069,596, 2.2.37. Treatment of fuel oil at 1000° F. and under 50–70 atm. pressure in which hydrogen and natural gas are injected into the residue and combine to form lower-boiling hydrocarbons. W. S. E. C.

Polymerization.

496. Conjunct Polymerization. V. N. Ipatieff and H. Pines. *Jour. Org. Chem.*, 1936, 1(5), 464.—A study has been made of the effect of sulphuric acid on the polymerization of the following olefinic hydrocarbons: *iso*propylethylene, trimethylethylene, butenes, mono-, di-, and trimers of *iso*butene, and trimers and tetramers of propene. Various conditions of temperature, concentrations of acid, and ratios of sulphuric acid to olefin have been investigated.

The results obtained from the treatment of olefines with concentrated sulphuric acid indicate that the following reactions occur: (1) polymerization, (2) depolymerization, (3) cyclization, (4) dehydrogenation, (5) hydrogenation and (6) isomerization. The term "conjunct polymerization" is used to describe the complex reaction which occurs on treatment of olefines with concentrated sulphuric acid, in order to differentiate this reaction from "true polymerization" which takes place when dilute acid is employed. The following general results were obtained:—

1. Olefines treated at 0° C. with large amounts of 96% sulphuric acid, yield a mixture of paraffins, olefines and *cyclo*-olefines. The fraction boiling up to 250° C. of the reaction product was predominantly paraffinic, whereas that boiling above 250° C. contained olefines and *cyclo*-olefines.

2. Treatment of olefines with small ratios of 96% sulphuric acid at 0° C. yielded a reaction product having a higher boiling range than that obtained when large quantities of acid were employed. This product consisted of a mixture of hydrocarbons, olefines being identified in the fractions boiling below 250° C.

3. The yield of paraffinic hydrocarbons increases with an increase in the ratio of concentrated sulphuric acid to olefines treated.

4. Treatment of olefines at −35° C. with either large or small amounts of 96% sulphuric acid yielded a product having a higher boiling range than the product resulting from similar treatment at 0° C.

5. Di- and tri-*iso*butene, when reacted with concentrated sulphuric acid, yield a product of substantially the same boiling range.

6. Olefinic hydrocarbons such as di*iso*butene or tri*iso*butene undergo chain cleavage followed by hydrogenation, when reacted with sulphuric acid. Thus, tri*iso*butene yielded a fraction corresponding to octane, whilst di*iso*butene yielded a fraction corresponding to dodecane.

7. *cyclo*-Olefines of the general formula C_nH_{2n-4} were found in the decomposition product of the sulphuric acid layer.

Sulphuric acid concentrations of 87, 77 and 67% do not cause the formation of paraffinic or cyclic hydrocarbons.

8. At higher temperatures dilute sulphuric acid causes depolymerization.

In order to investigate the various products obtained in these reactions, new analytical methods for the different types of hydrocarbons have been developed. H. E. T.

497. The Polymerization of Ethylene under Pressure. K. Peters and K. Winzer. *Brennstoff-Chemie*, 1936, **17**, 366–370.—Phosphoric acid in the liquid condition and deposited on carriers, such as kieselguhr and silica gel, together with various additions, were tested as catalysts for the polymerization of ethylene. An addition of 2% of titanic acid to phosphoric acid yielded the best results as measured by reaction velocity and percentage conversion. B. C. A.

498. New Polymerization Plant for California. Anon. *Nat. Petr. News*, 30.12.36, **28** (53), 9.—The new plant will operate on the waste cracked gases from a Dubbs unit of capacity 8000 brls. per day. The gas is expected to yield 5·8 gallons of polymer per 10^3 cu. ft. and the estimated output of the plant 12,000 gallons per day. The polymer has an octane number of 82, and a blending octane number of 110 with straight-run gasoline and 95 with cracked gasoline. H. G.

499. Unitary Thermal Polymerization Process. J. S. Carey. *Refiner*, 1936, **15** (12), 549–554.—This process operates on natural and refinery gases, converting them under controlled conditions of temperature and pressure into polymer gasoline of around 77 octane number. The C_3 and C_4 hydrocarbons are the chief components converted, although C_2 hydrocarbons are also reactive. The stock gases are first fractionated to give a C_3–C_4 liquid feed, which is converted at 800–1600 lb. pressure and 900–1100° F. temperature into crude polymer gasoline, which is then separated into end-point gasoline and fuel oil. Owing to low conversion per pass, a high degree of recycling is usually desirable, although other factors may render the maximum degree low. The polymer gasoline is refined by vapour-phase treatment with clay, a yield of 10,000 brls./ton being indicated. The manufacturing cost exclusive of fixed charges is given as 2·21 cents per gallon polymer gasoline for a yield of 1500 brls. per day. Extensive data are given on the yields obtained from various refinery and natural gases, and on the properties of the polymer gasoline. G. R. N.

500. Manufacture of Gasoline from Gases Spreading. C. O. Willson. *Oil & Gas J.*, 18.2.37, **35** (40), 21.—There are now 24 polymerization units either built or contracted for in domestic and foreign refineries, and one is being completed to operate with gases available from a natural gasoline plant. Installations are generally located at large plants, but as they will not have sufficient capacity to handle all available plant gases, further extensions are anticipated. Other refineries are also expected to instal plants in the near future. All new refineries and extensions of large capacity constructed during the past year have included a polymerization plant. Further possibilities in respect of production of both gasoline and special products are outlined. Installations licensed by the Polymerization Process Corporation, the Alco Products Co., Inc., and Pure Oil Co. are listed, showing the operating company, refinery, location and approximate capacity of each. Companies which have been licensed to operate catalytic polymerization or *iso*-octane plants by the Universal Oil Products Co. are also stated. R. A. E.

501. Patents on Polymerization. A. J. Van Peski. U.S.P. 2,067,030, 5.1.37. Polymerization of cracked gasoline in the presence of aluminium chloride to produce lubricating oil.

R. C. Osterstrom. U.S.P. 2,067,334, 12.1.37. Catalytic polymerization of unsaturated cracked distillates at 500–600° F. and under a pressure sufficiently high to maintain the distillate in the liquid phase.

V. Ipatieff. U.S.P. 2,067,764, 12.1.37. Treatment of cracked hydrocarbons to improve their knock rating by subjecting them to the action of olefin-containing gas at alkylating temperatures, in the presence of a calcined mixture of pyrophosphoric acid and infusorial earth.

F. H. Gayer. U.S.P. 2,068,016, 19.1.37. Polymerizing olefines at 300–400° C. by forming a gaseous mixture of the olefins with an organic halide which is then passed over a catalyst at 400° C. W. S. E. C.

Refining and Refinery Plant.

502. Development in Petroleum Manufacturing. Anon. *Refiner*, 1937, **16** (1), 2–22.—The general trend in petroleum refining practice and technology is definitely towards the utilization of new and scientific chemical engineering processes. The development and installation of these processes during 1936 are summarized under the following titles: domestic construction, foreign construction, polymerization, cracking, solvent processes, general distillation and treating. G. R. N.

503. Statistical Treatment of Refinery Problems. J. S. Walton. *Refiner*, 1937, **16** (1), 36–47.—Statistical computation is often the most reliable means of predicting the behaviour of a complicated system, since the comprehension of all the factors involved is usually impossible. It is a characteristic of all such mechanisms that the greater the number of individual similar parts comprising the system, the more amenable to statistical treatment the system becomes, also the more similar the individual parts of the entity the more accurate will be the deductions as to the group behaviour. Applying these concepts, it is shown that the T.B.P. curve of a crude oil gives a straight line on Hazen probability scale graph paper, and the slope of the line is a characteristic of the oil. Several practical applications of this method are discussed. The correlation of corrosion data has been made by use of probability curves between life and cumulative failures, and in the same way the author presents similar data on the failure of tubes in crude oil-heat exchangers and cracking units. G. R. N.

504. Modern Steam Engines in Refining Plants. F. J. Vonachen. *Refiner*, 1936, **15** (12), 564–569.—It is emphasized that, whenever possible, steam should perform the double duty of generating power and giving up useful heat. Modern steam engines can now be operated to eject steam free from cylinder oil, and therefore suitable for refinery processes. Two plant examples are given whereby steam manufactured for heating purposes was utilized to generate power at a cost considerably lower than if it were purchased. Improvements in the component parts of the modern steam engine are briefly discussed, emphasis being laid on the value of a new type of watershed partition between the cylinder and the crankcase. G. R. N.

505. Gasoline Treating Methods. A. L. Foster. *Nat. Petr. News*, 3.2.37, **29** (5), 63.—The lull in the development of refinery methods which succeeded the introduction of gum inhibitors has now given way to further activities. The search for refinery methods which will leave octane numbers unimpaired has resulted in several new processes. The Lachman process, using $ZnCl_2$, the Day process, the Schulze–Phillips copper chloride method and the lead sulphide process are cases in point. In fact, the choice of a particular process is becoming increasingly difficult, whilst the chance of investment in that process being wasted because of the introduction of a newer and cheaper process becomes an ever greater hazard. H. G.

506. "Aquila" Distillation Plant at Trieste. Anon. *Petr. Times*, 30.1.37, **37** (943), 131; 6.2.37, **37** (943), 183.—Built under the ægis of the Fascist Government, the Aquila refinery has been designed to operate on Iraqi crude. The crude will be topped in a two-stage atmospheric distilling unit, capacity 750 tons per day, and producing, on average, 15% gasoline, 16% white spirit, 21% kerosine, 8% gas oil. 40% of the residue will be distilled in a vacuum unit yielding heavy gas oil as the overhead product and three lubricating oil cuts. The asphalt yield will be 4% (on crude). The lube oil stock will be treated by the Edeleanu process using benzol and liquid SO_2. H. G.

507. Comparative Costs of Vapour Phase and other Treating Processes. M. R. Mandelbaum and P. Swanson. *Nat. Petr. News*, 9.12.36, **28** (50), 69.—It would appear to be impossible to generalize on the relative cost of refining cracked gasoline by clay contacting in the vapour phase and by acid washing. Specific figures depend on specific conditions which are peculiar to particular charging stocks, equipment, rate and volume of throughput, specifications of the treated products, etc. Data referring to particular installations and products are published. These show that the clay-

contacting process offers an economic advantage over the acid-washing and re-running process, as well as advantages of smaller treating losses and smaller reduction in octane number. H. G.

508. Pour-Point Inhibitor Patents. Anon. *Nat. Petr. News*, 2.12.36, **28** (49), 83.—The article surveys the American patents which cover processes having as their object the lowering of that temperature at which the freely flowing characteristics of an oil are impaired. The processes are mainly of two types: (*a*) the addition of an agent which alters the wax structure, (*b*) the addition of a diluent which effects an all-round reduction in viscosity. As early as 1867 the use of rubber as an addition agent was patented (Eames and Seely). Since then a great diversity of bodies has been used: chlorinated fatty acids and paraffins, esterified fatty acids, oxidized paraffin wax, extracts from cracking still residues and coil tars, cellulose naphthenate, blown fatty oils, the higher ethers, metallic soaps, etc. A *résumé* of 77 patents is given in an appendix. H. G.

509. Furnace Design. Anon. *Nat. Petr. News*, 2.12.36, **28** (49), 90.—Modern developments in furnace design have had as their object the provision of more even heating, with the elimination of local overheating of tubes and furnace walls. This has been accomplished finally by arranging for complete combustion of the fuel in muffles, one of which is provided for each burner. A horizontal row of these muffles is arranged in the furnace wall, whilst the tubes are arranged on the floor and roof of the furnace which slopes downwards from the back towards the muffles. Proper design of the furnace has eliminated eddies, and the maximum heat input in any particular part of the furnace is but little above the usual average input of 1500 B.Th.U. per sq. ft. When used on cracking plant, a pair of furnaces are usually built back to back, one being used for the preliminary heating, and the other for the soaking. Loss due to oxidation of the outside of the tubes and difficulties due to coke formation have been reduced to a minimum with this type of furnace. H. G.

510. Economical and Efficient Cleaning Methods for Refinery Tubes. G. F. Ilgen. *Nat. Petr. News*, 27.1.37, **29** (4), 63.—Recommendations are made as to the suitable methods for the removal of the deposit from all classes of refinery tubes. The use of some sort of rotary cutter is suggested, the particular design depending on the nature of the deposit to be removed. Compressed air, as the motive force, has the largest application, but water and steam find application where the removal of the detritus by air presents difficulties, or where the presence of explodable gases makes the use of air dangerous. Where deposits are too thick to allow of the insertion of the rotary cutter head, the use of a drill head in advance of the cutters is suggested. Emphasis is laid on the need for the careful selection of cutters and the control of speed, in order that excessive centrifugal force shall not damage the tube wall. Problems of lubrication are discussed. H. G.

511. Forced Circulation Applied to Steam Boilers. J. R. Darnell. *Nat. Petr. News*, 2.9.36, **28** (36), 25.—Discusses the new Velox type boiler, which has been used to a considerable extent in Europe, and shows the inter-relationship between steam-boiler practice and oil-still design by the use of propellers in both types of equipment. The author believes that it may be of advantage to designers of oil and cracking stills to investigate the possibilities of application of forced circulation, as exemplified by Velox methods, to the distillation of petroleum. W. W.

512. Conversion of Petroleum Coke into Carbon. Anon. *Petr. Eng.*, Feb. 1937, **8** (5), 190.—At a plant in Port Arthur, Texas, petroleum coke is calcined and converted into 99% pure carbon in a form suitable for artificial graphite manufacture. The coke is screened to remove 2 in. and larger pieces, which are sold for metallurgical purposes and for fuel, and the smaller pieces are passed to the upper end of a calcining furnace 125 ft. long by 8 ft. wide. In the lower end of this chamber gas-jets roast the coke as it travels downward, burning out the impurities. The red-hot coke is dropped out into a rotating cylinder, where it is cooled and passed to the warehouse.

The removal of oil, gas and moisture alters the electrical nature of the coke from

that of an insulator to a conductor, and the graphite produced is suitable for all types of electrodes, and use in electrical furnaces, dry cells and as motor brushes, etc.

C. L. G.

513. Application of Physico-chemical Principles to the Design of Liquid–Liquid Contact Equipment. Part V. Mass Transfer to Liquids in Turbulent Flow. L. C. Strang, T. G. Hunter and A. W. Nash. *J.S.C.I.*, 1937, **56**, 50T–54T.—The authors continue their work on the system phenol from kerosene to water, and investigate the possibility that, as the effective thickness of the laminar films which controls the rate of mass transfer is closely connected with the degree of turbulence, the individual film resistances in one liquid phase are affected by the flow of the second liquid phase, and hence the rate of mass transfer through the laminar film of core liquid may be governed to some extent by the rate of flow of the wall liquid. They further extend the data on which is based the previously obtained equation for the individual mass transfer coefficient of phenol through the kerosene core. It is concluded that in the kerosene–water system investigated the water rate has no effect on the mass transfer coefficient of the solute in the kerosene phase. T. C. G. T.

514. Volatility Index for the Refining Industry. A. L. Foster. *Nat. Petr. News*, 24.2.37, **29** (8), 87.—It has been stated that much of the remarkable advance made in recent years in engine performance is due to the adoption, in octane rating, of an anti-knock index. It is argued that the adoption of a simple volatility index would provide engine designers with a similar datum on which to develop carburettor and fuel systems. Two indexes have been suggested so far—that of Olderfell and Alden, and that of Hebl and Rendel. In the former the index is taken as the numerical difference between the 50% end-point temperature on the Engler distillation curve and 284° F. Hebl and Rendel developed a chart based on the 20% and 70% end-points. Both indexes have their champions. A further plea is made for rationalization and possible development of the volatility index. H. G.

515. Vanadium Catalysts. J. C. Olsen and H. Maisner. *Ind. & Eng. Chem.*, 1937, **29** (3), 254.—The suitability of vanadium catalysts in the manufacture of sulphuric acid by the contact process has been investigated, particular attention being paid to the question of poisoning by arsenic. Vanadium contact masses are subject to arsenic poisoning, and in the work undertaken in this research a distinction is made between arsenic incorporated in the catalyst during preparation and arsenic introduced into the gas stream by sublimation of arsenious oxide.

The results obtained indicate that all types of vanadium catalysts become poisoned by arsenic in the gas stream, provided the test is not prematurely discontinued. The conversion efficiency of a poisoned catalyst rises with increased temperature, but on restoration of the initial temperature conditions, the conversion falls back to its original value.

The resistance of a vanadium contact mass towards arsenic poisoning is not increased by addition of barium, which serves as a promoter for the vanadium.

H. E. T.

516. Relationship between Bleaching Powder and the Structure of Filter Clays. R. Fusstieg. *Nat. Petr. News*, 9.12.36, **28** (50), 64.—The zeolites, degradation products of felspar, are generally hydrated-alumino-silicates of Ca or Na. Felspar during its degradation forms two bodies:

$$KAlSi_3O_8 + H_2O \longrightarrow \underset{\text{(Water-soluble)}}{H_2KSiO_4} + \underset{\text{(Kaolin)}}{Al_2H_4SiO_9}$$

Thus the kaolin, by the slow leeching out of the water-soluble material, acquires a structure of sub-microscopic channels resulting in a very high specific area. To a large extent the adsorptive capacity depends on the degree of completeness of the leeching-out process. The zeolites seldom occur in the free state, being usually associated, as in the case of fuller's earth, with other argillaceous earths. Many earths function by virtue of both simple adsorption and the catalytic activity of some

other constituent, such as iron oxide or aluminium chloride. The *X*-ray examination of fuller's earths has shown that their activity varies with their content of montmorillonite, $H_2O_4,SiO_2,Al_2O_3 + nH_2O$, and to the extent to which water-soluble silicates have been leeched out of that body to produce a sub-microscopic structure. Bauxite, which has the added property of desulphurization, appears to function as a simple adsorbent, but its efficiency depends on its moisture content, and is always calcined before use. Other clays, *e.g.* Carnolit, contain carbonates or other basic material, and are able to neutralize as well as decolourise. Clays of montmorillonite type, *e.g.* bentonite, may be activated by extraction with acids. This process is dealt with at some length. H. G.

517. Mineralogical Character of the Smectites. J. de Lapparent. *Ann. des Comb. Liq.*, 1936, **11** (5), 863–944.—A comprehensive survey of some French fuller's earths capable of being used as decolorizing media. Smectites are defined as those argillaceous earths having a natural absorbent power. Some of these are decolorizing, and their decolorizing power can be increased by chemical activation. *X*-Ray diffraction photographs are used to study the mineralogical character of eleven earths. Theoretical evidence is put forward to support the claim that three argillaceous constituents—namely, halloysite (kaolinite), attapulgite, and montmorillonite—are present in the smectites. Practical conclusions are that there are ample supplies of attapulgite of moderate decolorizing power, but a paucity exists of earths which can be activated to be strongly decolorizing.

North Africa is thought to be a likely source of montmorillonite, which is considered suitable for activation. In those districts of France where it is known to occur it is considered unprofitable to work it on account of contamination.

J. L. T.

518. New Precoat Filter. Anon. *Nat. Petr. News*, 6.1.37, **29** (1), 67.—The filter is a development of the Oliver continuous filter. The drum is coated in the usual way with a filter aid, the surface of which is shaved away to present a clean surface for filtering. This removal of the choked surface may be continuous or intermittent, according to the relative rate of choking. H. G.

519. Patents on Refinery Plant. M. R. Fenske. U.S.P. 2,069,490, 2.2.37. E. G. Rogaty. U.S.P. 2,071,429, 23.2.37. F. L. Maker. U.S.P. 2,071,643, 23.2.37, and E. Watt. U.S.P. 2,071,909, 23.2.37. Improved fractional distillation apparatus for mineral oils. W. S. E. C.

Chemistry and Physics of Petroleum.

520. Isolation of an *Iso*nonane from Petroleum—its Fractionation from Naphthenes by Distillation with Acetic Acid. J. D. White and F. W. Rose, Jr. *Bur. Stand. J. Research*, 1936, **17**, 943–954.—In separating the constituents of an Oklahoma petroleum, a 35-litre fraction, b.p. 130–140° C., was obtained. After extracting the aromatics and redistilling, a 9-litre fraction, b.p. 92–94° C. at 215 mm., which was a mixture of paraffin and naphthene hydrocarbons, was obtained. This was systematically distilled and the distillate collected in 50-ml. cuts, which were sorted and combined according to b.p. and refractive index, and again distilled in an atmosphere of CO_2 to avoid decomposition.

An examination of the results revealed the presence of a fraction more paraffinic than the others, and with b.p. 135–135·5° C. This still contained a large amount of naphthene, which could not be fractionated by crystallization.

However, a relatively large fraction, consisting chiefly of paraffin constituent, was obtained by redistillation with glacial acetic acid.

Various fractions of this were cooled, but could not be induced to form crystals. However, when diluted with dichlorodifluoromethane, all the distillate b.p. 134·7–135·7° C. and with refractive index less than 1·408 crystallized readily.

Systematic crystallization produced a nearly pure sample of *iso*nonane, constituting in quantity about 0·1% of the original crude.

Its physical properties have been determined and compared with those of nonanes

known to boil near 135° C. It has properties similar to those of 2 : 6-dimethylheptane, but the agreement is not close enough to identify the compound completely.

D. L. S.

521. Naphthene Hydrocarbons of High Molecular Weight. J. Müller and S. v. Pilat. *Brennstoff-Chemie*, 1936, **17**, 461–465.—In view of the difficulty of isolating pure naphthene hydrocarbons of high molecular weight from petroleum, recourse was made to the conversion of the naphthenic acids naturally occurring in heavy petroleum into the corresponding naphthenes according to the scheme: $R.COOH$–$R.COOCH_3$–$R.CH_2OH$–$R.CH_2I$–$R.CH_3$. Using a lubricating oil distillate from a paraffin-free petroleum from West Poland, the naphthenic acids were extracted, converted and purified, yielding, after the removal of a solid compound of m.p. 49·5–54° C., n_D^{20} 1·4662, C 85·66% and H 14·09%, in the production of heavy oil fractions. The heaviest oil prepared was of d_4^{20} 0·8712, n_D^{20} 1·4787, C 86·09%, and H 13·92%, mol. wt. 388 and series formula C_nH_{2n-2}. The viscosity index was 89·1, viscosity gravity constant 0·8198, and viscosity 14·88 centistokes at 60° C.

The physical properties of both intermediate and final products were traced with special reference to the influence of molecular change on the viscosity–temperature properties. The carboxyl and hydroxyl groups manifest the most pronounced effect by increasing the viscosity and its dependence on temperature.

From iodides secured according to the sequence cited, hydrocarbons of double molecular size were prepared by condensation in benzol solution using metallic potassium, whereby naphthenic acids of d_4^{20}, 0·9647 yielded an oil of d_4^{20}, 0·9110; n_D^{20}, 1·5045, molecular weight 590 and viscosity index 92. B. C. A.

522. Production of Nitrobenzene from Spirit. M. V. Th. Cherchez. *Bulletin de Mathématique et de Physique, Bucharest*, 1934–5, **6**, 151.—Nitrobenzene is prepared from Arbanaşi spirit by treatment with a mixture containing 1 part of nitric and 1·5 parts of sulphuric acids. 250 gms. of the acid mixture are added to 300 c.c. of spirit and agitated mechanically for ½ hr. and left for 2 hrs. at 50°. A yield of 12 gms. of nitrobenzene is obtained amounting to 22·5%. W. S. E. C.

523. Kinetics of Gaseous Addition of Halogen Acids to *Iso*butene. G. B. Kistiakowsky and C. H. Stauffer. *J.A.C.S.*, 1937, **59**, 165–170.—The rate of gaseous thermal decomposition of *tert.*-butyl bromide has been investigated in the temperature region of 509–564° K. It was found to be a homogeneous unimolecular reaction. The equilibria of *tert.*-butyl bromide and *tert.*-butyl chloride with *iso*butene and the respective halogen acids were investigated in the region 361–533° K.

The paper gives the reaction rate constant for the decomposition and the heats of reaction, free energy changes and rate equations of the association reactions. The isomerization of *tert.*-butyl chloride to *iso*butyl chloride at 270° C. was investigated, and found to be less than 7·8% at equilibrium. W. E. J. B.

524. Cleavage of Side-Chains in Aromatic Hydrocarbons in the Form of Paraffins by Means of Aluminium Chloride. V. N. Ipatieff and H. Pines. *J.A.C.S.*, 1937, **59**, 56–60.—When an alkylbenzene is heated with *cyclo*hexane, the alkyl group is split off to yield the corresponding paraffin. Thus propyl-, *sec.*-butyl-, *tert.*-butyl-, and *tert.*-amyl-benzene when heated with *cyclo*hexane in the presence of aluminium chloride at temperatures of 67–82° C. yield respectively propane, butane, *iso*butane and *iso*pentane. The hydrogen necessary to hydrogenate the alkyl group is derived from the interaction of the two cyclic compounds, *e.g.*

$$R.C_6H_5 + C_6H_{11}[+ Al Cl_3] \longrightarrow RH + C_6H_5 - C_6H_{11}$$

Under similar conditions *iso*propylbenzene alone does not yield propane, but *tert.*-butylbenzene yields *iso*butane and high-boiling products.

The reaction written above is not the only one which occurs. For example, with *iso*propylbenzene and *cyclo*hexane, besides propane and phenyl*cyclo*hexane, the following products were identified: methyl*cyclo*pentane, benzene, *p*-di*iso*propylbenzene and a product corresponding to *cyclo*hexyl*iso*propylbenzene or methyl*cyclo*-

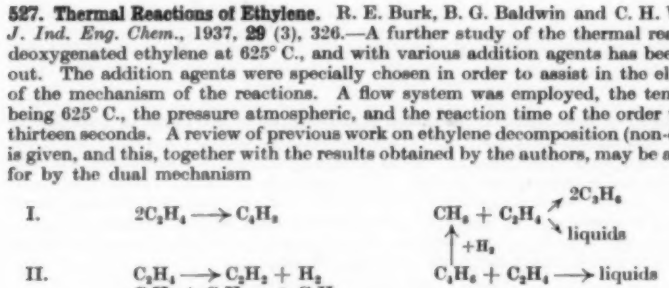
pentyl*iso*propylbenzene. The yield of paraffin gases formed appears to depend on: (1) the structure of the alkyl group and (2) the ease with which the *cyclo*paraffin gives off hydrogen. It appears that the ease of cleaving the *iso*propyl group from *iso*propylbenzene decreases with the substitution in the *cyclo*hexane ring. Similarly, it was found that decahydronaphthalene facilitates the cleavage of the alkyl group. A tertiary butyl group splits off more easily than a secondary butyl group, and the latter more easily than an *iso*propyl group, whilst under the same conditions ethyl and methyl groups do not split off. The relative instability of the alkyl groups attached to the benzene ring is the same as that predicted by Kharasch's table of the relative electronegativity of organic radicals (*J.A.C.S.*, 1932, **54**, 674). Some possible uses of the above reaction are outlined. W. E. J. B.

525. Mechanism of the Reaction between Aromatic Hydrocarbons and Compounds containing an Ethylenic Double Bond in the Presence of Aluminium Chloride. M. M. Costin, D. Nenitzesco, I. Gavat and G. Vanta. *Bulletin de Mathématique et de Physique, Bucharest*, 1934–35, **16**, 115.—If monochlorinated ketones resulting from the condensation of ethylene or propylene with an acid chloride be condensed with benzene in the presence of aluminium chloride, the phenyl group in the resulting ketone is attached to the carbon atom to which the chlorine was attached in the original chlorinated ketone.

If, however, these reactions be repeated with higher members of the olefines or cyclic olefines, it is found that the chlorine atom migrates away from the carbon atom to which the double bond was originally attached, thus if 2-chloro-1-acetyl*cyclo*hexane be condensed with benzene, the product is 4-phenyl-1-acetyl*cyclo*hexane. J. W. H.

526. Rate of Hydration of *Iso*butene in the Presence of Silver Ion. W. F. Eberz, H. J. Welge, D. M. Yost and H. J. Lucas. *J.A.C.S.*, 1937, **59**, 45–49.—*iso*Butene and silver ion in aqueous solution form a complex ion for which the formula $C_4H_8Ag^+$ and the equilibrium constant $(C_4H_8Ag^+)/(C_4H_8)(Ag^+) = 61{\cdot}7$ have been determined by distribution measurements. In 0·25*N*-nitric acid containing silver nitrate, the amount of *iso*butene which hydrates in unit time at a given concentration of total butene is much less than in the absence of silver nitrate, but is greater than corresponds to the amount of free butene. It was possible to derive satisfactory rate constants when it was assumed that only the free butene, present in the silver nitrate solution, hydrates. The average value of the constants is greater than the known constant in the absence of silver ion. Thus it is concluded that butene in the form of the silver complex does not hydrate. W. E. J. B.

527. Thermal Reactions of Ethylene. R. E. Burk, B. G. Baldwin and C. H. Whitacre. *J. Ind. Eng. Chem.*, 1937, **29** (3), 326.—A further study of the thermal reactions of deoxygenated ethylene at 625° C., and with various addition agents has been carried out. The addition agents were specially chosen in order to assist in the elucidation of the mechanism of the reactions. A flow system was employed, the temperature being 625° C., the pressure atmospheric, and the reaction time of the order twelve to thirteen seconds. A review of previous work on ethylene decomposition (non-catalytic) is given, and this, together with the results obtained by the authors, may be accounted for by the dual mechanism



Mechanisms I or II may predominate according to the choice of experimental conditions. The gaseous paraffins formed in small quantity during some of the experiments are accounted for by hydrogenation of the corresponding olefine or as thermal decomposition products. Under the experimental conditions employed, the reaction was found to be between the first and second order, to be homogeneous and retarded by packing. H. E. T.

Analysis and Testing.

528. Micro-analysis of Gases. Part IV. F. E. Blacet and D. H. Volman. *I.E.C. Anal.*, 1937, **9** (1), 44–45.—The determination of methane and nitrous oxide in the authors' apparatus is described. In this combustion is initiated and completed by a platinum wire at orange-red heat instead of by the usual spark. Methane is completely oxidized within two minutes to carbon dioxide, which is absorbed in the usual way. The combustion takes place over a hot mercury surface which is not oxidized over the short time involved. It was not possible to estimate butane in this way owing to the longer time of reaction. G. R. N.

529. Analysis of Coal Gas by Liquid Fractionation. W. J. Gooderham. *J.S.C.I.*, 1937, **56**, 26T–36T.—New apparatus and methods involving the fractional distillation of liquefied gases for the complete analysis of coal gas and for the determination of conjugated diolefines in coal gas are described. The apparatus is described in detail and illustrated with photographs and scale drawings. Results for the complete analysis of four types of coal gas are given and discussed from various standpoints. Unfortunately, in the necessary removal of carbon dioxide and water, other substances, such as mercaptans, cyanogen, carbonyl sulphide and amines, are also removed, so that it is necessary to determine these separately. The conjugated diolefines are determined after fractional distillation by the maleic anhydride method. The concentration of butadiene and other conjugated diolefines boiling between 20° and 80° C. in various coal gases and in water gas are given, and from the results it is concluded that the concentrations of conjugated liquid diolefines vary more than those of butadiene, that in gas from horizontal retorts and carburetted water gas there appears to be a rough correlation between conjugated diolefines and calorific values, and that for coal gas the concentrations of conjugated liquid diolefines are lowest in gas from horizontal retorts and highest in gas from vertical retorts.

Among the new apparatus and technique described are:

1. Low-temperature fractionating columns with ancillary apparatus.
2. A governor to control distillation pressures.
3. A method of sampling, in which liquid methane, condensed from coal gas, is used to scrub the gas free from other hydrocarbons and in which a portable container is used.
4. A Töpler pump recirculating clean mercury.
5. An apparatus to permit gas analysis at 100° C. and to avoid errors due to the solubility of gas and vapours in reagents. T. C. G. T.

530. Simple Apparatus for the Partial Saturation of Gas with Vapour. R. Chaplin and H. W. Cartwright. *J.S.C.I.*, 1937, **56**, 36T–37T.—This paper describes an apparatus and method based on the principle of diffusivity, which, operating in a single stream of gas flowing at any desired rate, allows the adjustment of a wide range of vapour pressures. T. C. G. T.

531. Analysis of Light Petroleum Fractions. S. S. Kurtz, Jr., and C. E. Headington. *I.E.C. Anal.*, 1937, **9** (1), 21–25.—The following method has been developed for petroleum fractions boiling between 40° and 200° C. 600 ml. of the sample are refluxed for one hour on a steam-bath with 60 gms. of maleic anhydride. The hydrocarbon layer is separated from the cooled sample and the maleic anhydride remaining is dissolved by adding just enough 10% caustic soda. This solution is added to the hydrocarbon layer, shaken, settled and drawn off. In sequence the hydrocarbon layer is washed with 100 ml. of 10% soda, then 2 × 100 ml. of water. The loss minus the handling loss gives the proportion of conjugated diolefins. 500 ml. of the washed material are then fractionated into the following cuts, 40°/70° C., 70°/100° C., 100°/125° C., 125°/150° C., 150°/180° C. and 180°/210° C., the density at 20° C. and refractive index at 20° C. of each cut being determined. A fresh untreated sample is then distilled to 125° C. (vapour temperature), and the distillate and residue are separately treated with 3 × 100% 91% sulphuric acid, washed with 70% methanol and distilled in a Hempel apparatus to a temperature 5° C. above the end-point of the original to eliminate the polymers. The two fractions are now combined and treated with

$2 \times 100\%$ 98% acid, then soda and water. The resulting fraction is separated into cuts of the above boiling ranges, and the density and refractive index of each cut are measured. The results so obtained are used in a 12-step calculation employing graphical analysis and a constant known as the refractivity intercept (refractive index—$0{\cdot}5 \times$ density) to express the composition of the sample in volume percentages of non-cyclic mono-olefins, cyclic mono-olefins, aromatics, naphthenes and paraffins.

G. R. N.

532. A Simple Laboratory Ozonizer. W. Sheehan and W. Carmody. *I.E.C. Anal.*, 1937, **9** (1), 8.—A quickly assembled ozonizer that can be operated for long periods and give satisfactory yields is described. It is constructed from a 600-mm. Pyrex Leibig condenser and a 10,000-volt transformer taken from a neon sign. G. R. N.

533. The Estimation of Organic Peroxides, especially in Fuels. H. Hock and O. Schrader. *Brennstoff-Chemie*, 1937, **18**, 6–8.—After reviewing existing methods and detailing their experience in a search for a more accurate procedure, the authors state that improved results are achieved by the use of stannous chloride, the liquors being acidified with hydrochloric acid to approximately 6*N*.

In an Erlenmeyer from which the air has been displaced by carbon dioxide, 10 c.c. of 1/5*N*-stannous chloride solution are introduced, followed by 10–20 c.c. of the fuel under test. The mixture is heated to 95° C. for 5 minutes on a water-bath, with shaking and the passage of carbon dioxide. A reflux condenser is fitted if necessary. To the mixture after cooling to summer temperature by immersion in cold water 20 c.c. of hydrochloric acid (sp. gr. 1·13) and 10 drops of indigo carmine solution $\frac{1}{4}\%$ are added. Under continued passage of carbon dioxide the excess of stannous chloride is titrated with 0·1*N*-ferric chloride. B. C. A.

534. Viscosity Conversion Charts. R. Grosholtz. *Nat. Petr. News*, 13.1.37, **29** (2), 151.—The interconversion of viscosities as determined in Saybolt, Engler and Redwood instruments may be carried out by the charts described. Viscosities at a particular temperature may be converted to the appropriate viscosity on another scale at another temperature involving the necessity of determinations at two different temperatures on the first scale. H. G.

535. New System with Ostwald Viscometers. E. H. Zeitfuchs. *Nat. Petr. News*, 17.2.37, **29** (7), 68.—The Ostwald Viscometer has been re-designed with the aid of Poiseuille's equation corrected for loss of head due to velocity in the capillary and capillary end effects.

$$K = \frac{U}{d} = \frac{\pi ghrt}{8VL} - \frac{mV}{8\pi Lt}$$

where U = absolute viscosity in poises; $\frac{U}{d} = K$ = kinematic viscosity in stokes, h = average head of oil in cm., r = radius of capillary in cm., L = length of capillary in cm., V = volume of oil flow, ml. in time t secs. $m = 0{\cdot}56$, a constant established experimentally for capillaries with trumpet-shaped ends, d = density at temperature of measurement gm./ml., $g = 980{\cdot}7$ cm./sec./sec., t = time in secs. Three tubes have been designed to cover the range of viscosities 30–5000 secs. Saybolt Universal. It is claimed that the aggregate effect of errors due to kinetic energy correction, drainage, surface tension, alignment and difference in head due to errors in filling to the proper height is 0·2%. The viscometers have been calibrated in terms of the Saybolt instrument by means of two oils the viscosities of which have been determined accurately in the latter instrument. The equation given above may be rewritten in the form $K = ct - \frac{c^1}{t}$, where c = the constant for the tube in use and $c^1 = 0{\cdot}0077$.

The construction of the tubes is discussed. For rapid control work a number of the tubes have been assembled permanently in a thermostat. H. G.

536. Viscometer with Detachable Capillary. M. Louis. *Ann. des Comb. Liq.*, 1936, **11**, 1149–1151.—The viscometer comprises a pear-shaped measuring-bulb which contains at its lower extremity a glass tube of funicular form, into which is fitted a

cork carrying a straight glass capillary tube. The latter has plain ends, so that it is possible by measurement to determine the mean values of length and radius. With a knowledge of the volume of the measuring-bulb it is thus possible to calculate the constant of the tube, and experiment has indicated that this agrees with the constant derived by comparison with other known viscometers.

Viscosities can be determined with oil flowing downwards with a gravity head, or by upward flow with suction applied at the top of the viscometer. A further advantage claimed is that different capillaries can be used with a given volume of liquid, or with a given capillary various volumes of liquid can be examined. W. E. J. B.

537. Detection of Animal Fats and Oils in Mixtures. S. H. Bertram. *Ole, Fette, Wachse*, 1937, (2), 13.—The following test is stated to be selective for all animal fats and oils (except lard) in mixtures with vegetable fats, etc :—

1-c.c. sample is mixed in a test-tube with 3 gms. trichloracetic acid, and is heated to 60° C. in an oil-bath for 5 minutes. 10 c.c. of chloroform are then added. A violet colour shows presence of animal fat or oil, including hardened whale oil. P. G. H.

538. Value of Adhesion Test. W. Riedel. *Asphalt und Teer*, 1936, **36** (49), 977–981.—The author reviews the question of adhesion of bituminous binders with particular reference to his method of test. A. O.

539. Influence of Presence of Water on Bleaching Earths. A. Berczellor and E. Erdheim. *Petr. Zeit.*, 27.1.37, **33** (4), 7–8; *Ole, Fette, Wachse*, 1936, (15), 1.—The effect of varying quantities of water on bleaching earths was investigated and the decolorizing values were measured using a Lange–Roth photomer and expressed as percentage of the original oil. It was found that the improvement in the effect varied with the earth. Activated earths required an optimum 1·5–35% of water for the best effect, whereas natural earths required less. In the case of rapeseed oil and castor oil the optimum was 30–40% of water. The presence of water generally increased the activity of the earth. It is suggested that this is probably due to the separation of ions. W. S. E. C.

540. Fuel Tendency to Coat Heater Coils (Test for). A. H. Batchelder. *Nat. Petr. News*, 18.11.36, **28** (47), 40.—The apparatus comprises an oil container, capacity 1 quart, a heating element and a water-bath. The heater consists of an outer steel tube 0·7 in. diameter, 10 in. long, and closed at one end. Steam at 135 lb. pressure is introduced into the tube through an inner tube ¼ in. diameter, which is fixed centrally into the outer tube and reaches to within ⅜ in. of the bottom of the latter. The heater is screwed centrally into the oil container, which is placed in the water-bath maintained at 60–80° F. The outside of the heater is polished at the commencement of the test. The oil container is filled, heated for 24 hours, cooled, emptied, refilled with fresh oil and reheated. The cycle is repeated three times, giving a total test time of 96 hours. The aggregate deposit is estimated by washing container and heater with benzol and filtering on a Gooch crucible. Owing to the fact that an erratic deposition occurs at the surface of the oil, deposit on container and heater above line 7½ in. from the bottom is ignored. The results obtained are, naturally, empirical, but are claimed to be reliable for classifying cracked fuels according to their stability to heating. H. G.

541. Development and Operation of a Sample Shipping Department. G. F. Fitzgerald. *Refiner*, 1936, **15** (12), 577.—After stressing that frequently the refinery laboratory is not equipped or organized to handle the multitudinous variety of samples normally requested, the author gives a suitable procedure that will operate semi-automatically and ensure minimum time wastage. G. R. N.

Motor Fuels.

542. Production of Premium Diesel Fuels. Part I. G. M. Woods. *Petr. Eng.*, Nov. 1936, **8** (2), 90.—The significant characteristics of present high-speed diesel fuels obtained from petroleum fractions may be grouped under nine headings: (1)

Ignition quality or delay between injection of fuel and its ignition. The longer the delay period the greater is the tendency to cause knocking, and excessive delay may permit unburned fuel to reach the cylinder walls, resulting in oil dilution and carbon deposits in ring grooves. Ignition quality is of particular importance in automotive and aircraft diesel motors. Ignition quality of diesel fuel improves with paraffinicity of stock, and straight-run fuels are generally better than cracked. Refining processes affect the quality, *e.g.* hydrogenation, solvent extraction, use of "dopes." Methods of test for ignition quality are discussed, and a relationship between diesel index and critical compression ratio is given. (2) Viscosity limits are fixed as to maximum by the necessity for ensuring uniform fuel supply to the engine, and as to minimum by the lubrication requirements of injection pump plungers and barrels. (3) A.P.I. grav. is an indication of paraffinicity. Other things being equal, the higher A.P.I. grav. stocks are better for aviation purposes, owing to higher cal. val. per lb., whereas lower A.P.I. grav. stocks are economical for land installations owing to higher cal. val. per unit volume, the normal basis of purchase. (4) Boiling range. The I.B.Pt. is fixed at about 400° F. min. on account of Fl.Pt. requirements. Fractions boiling above 735° F. tend to burn slowly in the diesel engine, giving rise to soot and carbon formation, dilution, etc. (5) Cloud and pour points are of importance in connection with fluidity, clogging of filters, etc. (6) Low sulphur content is desirable, but fixation of the upper limit is the subject of much controversy. (7) Carbon residues of 0·2% or lower should be maintained for high-speed diesel fuels. The test is also a safeguard against contamination in handling and manufacture. (8) Colour is of little importance, except as an indication of care in refining and handling. (9) Acidity and corrosion. Fuels should be non-corrosive and substantially neutral. The use of "dopes" to improve ignition quality should be watched closely, and easily oxidizable and unstable materials should not be used.

Part II. Dec. 1936, **8** (3), 58.—Reviewing the possibilities of establishing large supplies of high-grade premium diesel fuels from available crudes by careful selection of raw materials and suitable refining methods, characteristics of straight-run diesel fuels from various crudes are tabulated with yields. A curve shows the relation between pour point and diesel index for all these fuels, and indicates that a straight-run fuel of 60 diesel index will have a pour point of approximately 15° F., which limits the temperature at which the fuel could be used. At the present time engines in use for 'bus and aircraft service seem to require a fuel of at least 60 diesel index for satisfactory service. For general winter use it is believed that pour points would have to be reduced to approximately − 30° F. and cloud points to − 20° F. This corresponds with diesel index of about 43–48. New methods of preparation of premium diesel fuels are thus indicated. Possible methods are:

(1) Hydrogenation of straight-run or cracked diesel fuels. (2) Lowering pour points of paraffinic straight-run fuels by (*a*) mild cracking; experimental cracking tests indicate that the method has but limited application, since in reducing the pour point of a Texas fuel from 35° F. to − 20° F. the diesel index was reduced from 62 to 50. (*b*) The use of inhibitors; wool fat and paraflow are limited in effect, but discovery of a good pour-point depressor would be important. (*c*) Dewaxing; the diesel index of dewaxed oil is lower than that of the stock, so that only stocks of high diesel index can be treated. Process losses are also high, but dewaxed oil of a given diesel index has a lower pour point than that of a straight-run fuel of similar diesel index. (3) Solvent treating: (*a*) by treating cracked diesel fuels produced by cracking gas oil for naphtha production with liquid SO_2 in varying proportion up to 500%, oils of high diesel index and low pour point were produced, but the yield of raffinate was low. The extract may, however, be used for further cracking to better gasoline. A raffinate of 70 diesel index and − 15° F. pour point was made, the yield being 41%. On addition of paraflow (0·5%) the pour point was reduced to − 50° F. (*b*) Straight-run diesel fuels of low diesel index do not respond so well to solvent treatment as cracked fuels. (4) Acid treating cracked or straight-run fuels. Experimental treatments indicate that chemical costs would be too high for commercial application, and solvent extraction appears more feasible and less wasteful. (5) Selective blending of high-grade straight-run fuels with low-grade straight-run and cracked fuels has a very limited application judging from results of tests on experimental mixtures. (6) Addition of "dopes." No work was carried out on this phase of the problem. Organic nitrates appear to be satisfactory and useful in improving ignition quality.

R. A. E.

543. Recent Developments in the Manufacture of Anti-knock Gasolines. R. Fusstieg. *Petr. Eng.*, Jan. 1937, **8** (4), 86.—The article describes the application of the processes of cracking, hydrogenation, destructive hydrogenation, and polymerization to the production of motor fuels of high anti-knock value. The fundamental principles underlying each process are outlined, methods of operation briefly described, and the properties of the gasolines produced discussed. Special attention is devoted to the pyrolysis and polymerization of gaseous hydrocarbons. R. A. E.

544. Aviation Spirit Specifications. Anon. *Mon. Petr. Roum.*, 1937, **38**,265–266.—These specifications, issued apparently by the Roumanian Ministry of Air and Marine, cover a straight-run petrol of 73 octane number, and ethylized petrols of 78, 82 and 87 octane number. T. C. G. T.

545. Patents on Motor Spirit. W. W. Triggs. E.P. 459,599, 11.1.37. Purifying crude benzole by leading the vapours through carbolic acid, cresol or homologues containing tar acids from low-temperature tars. The oil is then freed from basic impurities and pyridine acid residues by acid treatment followed by alkali and a mixture of bleaching earth and barium hydroxide.

A. L. Mond. E.P. 459,722, 12.1.37. Stabilizing of motor fuel by adding a natural mixture of alkali-soluble constituents isolated from normal tar fraction and of boiling range 200–325° C.

Universal Oil Products Co. and A. L. Mond. E.P. 459,923, 18.1.37. Stabilization of cracked spirit by adding an inhibitor, *e.g.* cresol, pyrocatechol, etc. The spirit is first freed from light ends which normally evaporate under atmospheric storage conditions and have a greater affinity for oxygen and an adverse effect on the inhibitor.

E. Solomon. E.P. 460,379, 27.1.37. Fuel oil and motor spirit are prepared by combining two mixtures each containing as primary ingredient, products of coal distillation with a resinous compound.

N. V. de Bataafsche Petroleum Mij. E.P. 460,746, 3.2.37. The anti-knock value of motor spirit is increased by adding derivatives of iron or cobalt carbonyl hydride.

P. J. Roelfsema. U.S.P. 2,069,329, 2.2.37. Refining of distillates containing sulphur compounds by rectifying the fractions in a distilling zone with nitromethane.

H. Tropsch. U.S.P. 2,069,785, 9.2.37. Pyrolytic conversion of butane–propane fractions in admixture with recycle stock. An intermediate fraction is separated from the effluent, consisting of hydrocarbons containing three and four carbon atoms.

A. E. Pew, Jr. U.S.P. 2,069,847, 9.2.37. Process for increasing the anti-detonant quality of gasoline by reforming straight-run gasoline and admixing in the liquid phase with fuel oil of which the initial b.p. is above the end point of the gasoline constituents. The mixture is then heated without cracking and then fractionated.

J. C. Morrell. U.S.P. 2,070,295, 9.2.37. Refining of cracked gasoline by dividing into light and heavy cuts. The light cut is subjected to oxidation, and to the effect of a polymerization inhibitor and then blended with the heavier cut after it has been desulphurized by treatment with hydrogen and a catalyst.

E. W. Thiele and F. W. Scheineman. U.S.P. 2,071,590, 23.2.37. Extraction of petroleum and cracked naphthas by means of SO_2. W. S. E. C.

546. Power Alcohol Policy. Anon. *Petr. Times*, 9.1.37, **37**, 39.—The article describes authoritatively the recent world trends in the production of alcohol for power. The production of alcohol for power is fostered for reasons of agricultural assistance and/or national self-sufficiency. The cost is always disproportionately high, and in the case of the agricultural fraternity, usually entails disadvantages in the form of an increase in transport costs greater than the advantages accruing from a bigger demand for its products. In Denmark the experiment has been officially confirmed as a failure, and many other countries have refused to bind themselves to any declared policy with regard to assisting the production and sale of power alcohol. Better prices for

agricultural products are reducing the interest hitherto displayed, but the cry for self-sufficiency on the part of some countries suffices still to excuse the subsidizing of an uneconomical scheme. H. G.

Lubricants and Lubrication.

547. Three Phases in which a Lubricant May Function. A. W. Burwell and J. D. Camelford. *Nat. Petr. News*, 24.2.37, **29** (8), 90.—The authors reach sundry conclusions from the results of determinations of coefficient of friction/pressure curves and coefficient of friction/temperature (at constant pressure) curves. They recognize three distinct regions in which a lubricant may function without permitting complete breakdown: 1. Full fluid film in which increase of temperature produces a decrease in the coefficient of friction. 2. Adsorbed or "oiliness" region in which the action of the adsorbed constituents are not predictable from the physical examination of the lubricant. 3. Boundary lubrication where the lubricating film is destroyed and reformed repeatedly and metal-to-metal contact occurs. They submit that the heterogeneous nature of even a simple lubricating oil does not preclude the assumption that segregation, to the metal surface, of some constituent of the lubricant occurs, even under full film conditions. In adsorbed film lubrication the film may be solid or liquid, according to the nature of the adsorbed constituent. If solid, the coefficient of friction will remain fairly constant, or perhaps show a small increase with increase in temperature; if liquid, a diminishing coefficient of friction will result. In boundary lubrication increase of temperature produces an increased coefficient, owing to the more frequent rupture and less frequent reformation of the boundary film.

H. G.

548. Relationships between Physical Properties and Chemical Constitution of Lubricating Oil Fractions. B. J. Mair and C. B. Willingham. *Bur. Stand. J. Research*, 1936, **17**, 923–942.—A number of "key" fractions obtained by distillation and extraction from a "water-white" lubricating oil (B. J. Mair and S. T. Schicktanz, *Bur. Stand. J. Research*, 1936, **17**, 909–922) were selected, and a correlation of their physical properties with each other and with those of synthetic hydrocarbons of high molecular weight has been made. The following properties were compared: densities, specific refractions and dispersions, optical activities, viscosity and viscosity indices, aniline points and boiling points.

It appears that the material corresponding to most highly refined product obtained by any good solvent extraction process, *i.e.* the least soluble portion of the oil—consists substantially of naphthenes (*cyclo*paraffins) with one to about three rings to the molecule, together with the necessary alkyl radicals.

The somewhat more soluble portion consists of naphthenes with more rings, together with some unsaturateds and perhaps some aromatics.

No evidence of the existence of *iso*- or branched-chain paraffins was found in this oil.

It is possible—because of similar solubility relationship—that at present one-ring aromatic hydrocarbons are being discarded to waste together with undesirable 6-ring naphthenic compounds. This should be investigated, since these aromatics may be of great value in a good lubricating oil. D. L. S.

549. Viscosities of Oils at High Rates of Shear. S. M. Neale. *J.S.C.I.*, 1937, **56**, 140–141.—The author calculates the power losses for a 6-cylinder engine with a 7-bearing crankshaft, dimensions given, at various oil viscosities, which losses are stated to be far higher than the actual.

The author's opinion is that the fundamental law of viscous flow no longer holds for so-called "normal" liquids at very high velocity gradients of the order of 10^6 sec.$^{-1}$ as found in a high-speed journal.

It is now suggested that with increasing velocity gradients the molecules in the bulk of the fluid, apart from those in the adsorbed layer, become more and more oriented, until finally, at very high speeds, the orientation is almost complete and the fluid friction no longer increases with the velocity.

Some preliminary experiments are described which appear to substantiate the claims that the classical laws break down at high velocity gradients. W. E. J. B.

550. Selection of Oils for High-output Aircraft Engines. A. L. Beall. *J.S.A.E.*, 1937, **40** (2), 48–55.—Limitations to the method of selecting oils for high-output aircraft engines by leaving it to the oil refiner are possible lack of experience in the particular field, or partiality to an unsuitable crude or refining process. Similarly, specifications alone are an unsatisfactory criterion, since there is apparently no correlation between the properties specified and behaviour is a high-efficiency aircraft engine. For the present, specifications will continue to perform the important function of identification, but for the future it is considered there is ample evidence for the necessity for a clause to determine how well the oil will lubricate. Wear of the tapered piston-ring face after an engine test is suggested as a control on lubricating power. The advantage of the full-scale engine test advocated is that it proves the oil, and, if carefully completed, rates it comparatively with other oils tested under similar conditions. To judge whether an oil merits a full-scale engine test, it is first tested completely in the laboratory, and, if suitable, it must then pass the W.A.C. oxidation test described in Appendix I to the paper. Briefly, 3·5 mls. of oil are heated in an aluminium cup to 550° F. for a total of 5 hours, 3·5 mls. of fresh oil being added at intervals of 30 minutes. In addition to this test, a bearing test is conducted, the viscosity of the oil being changed by external heating to give a steady end-leakage. Then follows a 50-hour test in the engine, samples being withdrawn at intervals of 5 hours for analysis. The engine is inspected after the test for wear of parts, carbon, gum and sludge, whilst the oil is tested for sludge, asphaltenes, viscosity and neutralization number. A complicated arbitrary system of point scoring is adopted to evaluate engine and oil condition. This is described fully in Appendix III to the paper. J. L. T.

551. Ageing of Lubricating Oils in I.C. Engines. A. Maillard, A. Acker and F. Rengade. *Ann. des Comb. Liq.*, 1936, **11** (5), 945–966.—Tests were carried out on oils in use in diesel-engined boats operating on the Far-Eastern service, and also on oils in use in petrol-engined road vehicles in private and in army service. On the diesel-engine lubricants determinations of dissolved gas and its oxygen and carbon dioxide content, density, acidity, viscosity, asphalt, solid impurities and ash were carried out, and on the petrol-engine oils the above tests were repeated, with the exception that dilution replaced gas content. The results on the diesel-engine oils indicate, it is claimed, that the sump is not the main seat of ageing, but rather those parts of the engine operating at high temperatures, *i.e.* cylinder and piston. The phenomenon is mainly one of high-temperature oxidation. Further tests are in view to determine to what extent this is accompanied by pure pyrogenation. It is considered that in all the cases studied the most important product of oxidation is the deposit insoluble in chloroform. The soluble deposit, a kind of asphalt, is partly soluble in the oil, but the larger proportion of it is in suspension in the oil; *i.e.* there is a kind of equilibrium affected by many factors. The fact that the soluble portion decreases while the insoluble portion increases with time is considered to indicate a change from the first to the second. In accelerated ageing tests it is considered necessary to work at temperatures of the order of those to which the oil will be submitted in the hottest parts of the engine. It is considered that the petrol engine is not so harsh on the oil as is the diesel engine. However, the average service life of the oil in a petrol-engined vehicle is about 50 hours, whereas in a diesel engine on a ship the oil is kept in service for 800 hours. On the other hand, the petrol engine is making more frequent stops, which means that the sump is being constantly replenished with oxygen. Tests done on two grades of oil used in petrol engines show that of the matter precipitated by normal benzine, the proportion soluble in chloroform is 80%, whereas in the case of the diesel-engine oil the figure is only 40%. Temperatures of 200° C. with aluminium pistons and 400° C. with cast-iron pistons are considered to prevail in engines, and some preliminary experiments on pyrogenation of four mineral oils have yielded results of 380–400° C. when heating under atmospheric pressure with the formation of a permanent gas as the criterion.

The article concludes with a note on the most efficient manner of withdrawing representative samples of oils after engine testing. J. L. T.

552. Anti-Oxidants for Lubricants. J. H. Byers. *Nat. Petr. News*, 10.2.37, **29** (6), 67.—Baird in 1872 obtained British Patent 1516 in connection with the use of elementary

sulphur in inhibiting the effects of oxidation on lubricating oils. Since that time many and various bodies have been suggested as anti-oxidants. Organic amines and hydroxy-bodies form the two principal classes. Other bodies mentioned in patent literature include metal derivatives, such as chromium oleate and copper carbonate, mercaptans, organic disulphides, polycarboxylic acids, elementary phosphorus, phosphites, etc. The article concludes with a brief review of the most important American patents on the subject. H. G.

553. Quantitative Determination of Adulteration of Lubricating Oils by Means of Identifiers. Part I. S. Fischer. *Petr. Eng.*, Jan. 1937, **8** (4), 128.—A method is described by which the amount of adulteration to which particular Pennsylvania-base oils were subjected in the trade could be determined.

Ingredients added to the oil had to be cheap and non-injurious, the test had to be convincing and visual, proof against addition of dyes, etc., and the identification permanent as to time, heat, light and ultra-violet rays. A colorimetric test was decided upon, and the development of the investigation is given in detail. One of the identifiers selected was a solution of phenolphthalein in *cyclo*hexanol prepared by heating the mixture to 212° F. until a clear solution was obtained. The phenolphthalein content of the finished stock was 1·15 lb. per gal. 224 mls. of this solution were added to 2000 gals. of oil by means of a burette, and the mixture was thoroughly agitated for 30 minutes. The identification test was carried out by shaking 15 mls. of oil with 15 mls. of ether, adding 15 mls. of a solution of sodium carbonate (1 gm. per 100 mls.) and shaking for 10 minutes. After settling, the lower layer containing phenolphthalein was, of course, coloured pink. When testing a sample for adulteration, a test on a standard oil sample was made at the same time under identical conditions. By comparing the depth of liquid from the adulterated sample required to match the colour of a given depth of liquid from the standard sample in Nessler tubes, the amount of adulteration can be ascertained. Adulterations up to 70% are readily detected by this method, and for greater adulteration larger quantities of oil and ether, but the same amount of carbonate solution, can be used for the identification test.

Part II. *Petr. Eng.*, Feb. 1937, **8** (5), 70.—A large number of indicators and oil-soluble dyes were tested, but found not to interfere with the method. Towards sunlight, ultra-violet ray and heat (up to 527° F.) the identifier was immune. The cost per gal. of oil treated was about $0·000116.

Oil Brown M was also examined as an identifier. A stock solution of dye in oil was made and the solution added to the oil heated to 150° F. with thorough agitation. The procedure for the identification test was similar to that employed for phenolphthalein, but a solution of potassium hydroxide (16 gms. in 200 mls. methyl alcohol/water) was used as test solution. Concentration of Oil Brown M in oil used was 0·08 gm. per gal., the cost for treating about $0·00036 per gal. and accuracy of identification within 2%.

In order to cover up the phenolphthalein colour reaction an indicator was sought the acid reaction of which would give approximately the same tint as phenolphthalein in an alkaline solution. A solution of 11·2 gms. of methyl red in 111 gms. of pyridine added to 2000 gals. of oil was found suitable. The test solution used in this case was 500 mls. concentrated hydrochloric acid made up to 1 litre with distilled water. Care was taken to remove all acid from the oil in the identification test. Methyl red is stable to heat, but not to light. Due to ease of identification, it is not suitable when used alone for the purpose in hand. Cost of treatment was about $0·00022 per gal. of oil. Accuracy of identification was found to be within 2%. R. A. E.

554. Extraction with Acetone of Substantially Constant-Boiling Fractions of a "Water-White" Lubricating Oil. B. J. Mair and S. T. Schicktanz. *Bur. Stand. J. Research*, 1936, **17**, 909–922.—A "water-white" oil was obtained by successive treatments of a lubricating fraction, viz.: (1) extraction with SO_2, (2) separation of wax by crystallization at − 18° C. from ethylene chloride, (3) filtration through silica gel.

This oil was separated by high vacuum distillation into constant-boiling mixtures, and charges were prepared for extraction by mixing according to their viscosities fractions of about 45 gms. each. Extraction was carried out in special columns 14 m. in length, a full description of which is included in the paper. Each charge of about 500 c.c. was separated into 25–35 fractions, which were each examined for

kinematic viscosity at 100° and 210° F. as well as for refractive index. In addition to this, carbon–hydrogen ratios, molecular weights, densities, dispersions, optical activities, b.p. and aniline points were determined on about 30 " key " fractions.

D. L. S.

555. Fatty Acid Derivatives in E.P. Lubricants. A. W. Ralston, C. W. Christensen, E. J. Hoffman, W. W. Selby and V. Conquest. *Nat. Petr. News*, 9.12.36, **28** (50), 59.—The paper presents preliminary work carried out on the preparation, use, properties and testing of sundry nitriles, ketones and amides of fatty acids. Means of preparing these bodies at nominal cost have been found. The nitriles, RCN, are either solids of low m.p. or liquids, their precise properties depending on the number of C atoms in the R group. They are very soluble in all mineral oils, are stable on heating up to 450° C. and are non-corrosive. They possess the oiliness common to polar groups. When nitriles of high molecular weight are heated under pressure to 550° C. they may be cracked preferentially in the C chain to yield a mixture of lower chain nitriles containing 5–12 C atoms, together with straight-chain hydrocarbons. The resultant mixture possesses very pronounced penetrative properties. Nitriles are polymerized when heated for long periods in the presence of catalysts. The polymers exhibit marked E.P. lubricating properties both when used alone and in admixture with mineral oil. Symmetrical ketones of the type R—C(=O)—R are only sparingly soluble in mineral oil, but mixed ketones R—C(=O)—R^1 prepared by a suitable Friedel and Craft reaction have been found to be easily soluble in mineral oil and to impart interesting properties thereto. They possess marked polar properties. Those prepared from high-boiling-point coal-tar distillates and stearyl chloride function as pour-point depressants. Ketones containing a phenoxyphenyl group, *e.g.* phenoxyphenyl heptadecyl ketone, produce gels when added to mineral oils. These gels liquefy under slight pressure, and re-gel when the pressure is released. The amides are of limited interest owing to their limited solubility, but certain thioamides with marked polar properties and fair solubility have been examined. The Faville–Le Valley machine and the Stephens Consistometer were used in assessing oiliness and load-carrying capacity.

H. G.

556. Metallic Wear. H. W. Brownsdon. *Petr. Times*, 26.12.36, **36**, 819.—In order to study problems associated with the fouling of dies used in the drawing of hollow non-ferrous metal products the author used a standard wheel of hardened steel (D.P. hardness 775) 1 in. diameter, 0·10 in. thick with a peripheral radius of 0·05 in. The test-pieces were plates ¼ in. thick, 2 to 3 in. long and ½ to ¾ in. wide. The surface finish was given by polishing with " 00 " emery paper, the wheel being polished after each test. All tests were carried out under conditions of flooded lubrication at about 68° F. The wear produced in the test-piece was assessed by a measurement of the major axis of the eliptical impression, and was taken as a measure of the fouling of the wheel. A systematic series of tests showed that alloys vary considerably in the amount of fouling of the wheel which they would cause. With a lubricating oil, viscosity Redwood 40 seconds at 200° F., alloys containing Zn produced the most fouling, Al bronzes little and Cu, Sn-bronze and cupro-nickel none. When a soap solution was substituted for the mineral oil, fouling increased with Cu, Al-bronze and cupro-nickel and decreased with brass and Ni-silver. The hardness of the test-piece did not appear to affect the degree of fouling. It was also found that while under constant conditions wear increased with time and for a given time with speed, for a given number of revolutions of the wheel, wear decreased with speed. The article concludes with the warning that the results obtained are a function of the specific conditions of the apparatus and tests, and should not be used as a basis of general conclusions.

H. G.

557. Preparation of Pure Oleic Acid. J. B. Brown and G. Y. Shinowara. *J.A.C.S.*, 1937, **59**, 6–8.—Oleic acid of a high degree of purity has been obtained by direct crystallization of the acids of olive oil from acetone. In brief, the method involves

the removal of the saturated acids by the — 20° C. acetone precipitation, crystallization of the resultant unsaturated acids from acetone at — 60° C., four or more times, followed by a partial crystallization of the resultant product from acetone at — 35° C. This removes small amounts of palmitic acid not taken out by the original treatment at — 20° C. No soap preparations are involved after the original saponification of the olive oil and conversion of the soaps so obtained into fatty acids. On three specimens obtained, the following constants were found: M.p. ° C. 13·0, mean molecular weight: 282·2/282·5, iodine no. (Wijs, thirty minutes) 89·63/90·04, n^{20} 1·4585.

The boiling points of one sample at various pressures were determined as below. At 15, 10, 5 and 1·2 mm. the corrected b.p. ° C. were 234–235, 225–226, 215–216 and 200–201. W. E. J. B.

558. Patents on Lubricating Oil. J. Y. Johnson. E.P. 459,310, 6.1.37. Purifying tricresyl phosphate used for extraction of phenols.

N. V. Bataafsche Petr. Mij. E.P. 459,442, 4.1.37. Apparatus for the extraction of two or more liquid mixtures.

L. W. E. Townsend. E.P. 459,789, 11.1.37. Stabilizing of lubricating oils by adding stannous oxide or hydroxide prepared in a colloidal form from stannous acetate and a soap-forming fatty acid.

B. C. Allibone, H. C. Allan and Burmah Oil Co., Ltd. E.P. 459,595, 11.1.37. Solvent extraction of hydrocarbon liquids using liquefied SO_2.

P. J. Beyer. E.P. 460,474, 28.1.37. Preparation of lubricating oil from vegetable oils.

J. Grosjean and P. R. E. Lewkowitsch. E.P. 460,532, 29.1.37. Vacuum distillation apparatus for the distillation of high-boiling-point products.

Texaco Development Co. and C. C. Towne. E.P. 460,583, 29.1.37. Production of improved lubricating oils by adding a substance obtained by the treatment of anhydrous solutions of rubber with halide salts of amphoteric metals having residual or secondary valencies, *e.g.* stannic chloride or bromide, boron trichloride.

M. B. Miller and Co. and M. H. Tuttle. E.P. 460,902, 8.2.37. Solvent extraction of lubricating oil using liquid propane and toluidine.

Naamlooze Vennootschap Machinerieen-en-Apparaten Fabriken, "Meaf." E.P. 460,906, 8.2.37. Process for the separation of hydrocarbon mixtures by solvent extraction.

W. B. Kay. U.S.P. 2,066,686, 5.1.37. Solvent extraction of lubricating oils using cresylic acid.

E. W. Gard. U.S.P. 2,066,933, 5.1.37. Process for treating acid sludge.

F. X. Govers. U.S.P. 2,067,050, 5.1.37. Dewaxing of hydrocarbon oil by filtration in the presence of liquid SO_2, anhydrous alcohol, acetone, etc., in order to increase the rate of filtration.

R. E. Manley. U.S.P. 2,067,128, 5.1.37, and U.S.P. 2,067,198, 12.1.37. Dewaxing of hydrocarbon oil using liquefied propane and butane.

L. A. Clarke. U.S.P. 2,067,137, 5.1.37. Solvent refining of lubricating oil using acetyl-diethylamine.

L. D. Jones. U.S.P. 2,067,193, 12.1.37. Dewaxing of hydrocarbon oil using 1,1,1. trichlorethane and one of the following: ethylene or propylene dichloride.

F. A. Headson. U.S.P. 2,067,396, 12.1.37. Apparatus for reclaiming used lubricating oil.

M. R. Fenske and W. B. McCluer. U.S.P. 2,067,627, 12.1.37. Method of flashing mineral oils.

C. F. Tears. U.S.P. 2,067,802, 12.1.37. Decolorizing of lubricating oil by heating the oil with liquefied propane under a pressure of 150 lb./sq. in. and passing the heated mixture under pressure through clay.

G. H. B. Davis and J. J. Wasson. U.S.P. 2,068,847, 26.1.37. Refining mineral oils by treating with 50% H_2SO_4 in the presence of 1–3% of added toluene.

W. J. McGill. U.S.P. 2,069,170, 26.1.37. Refining of lubricating oil using propane.

B. M. Carter, T. V. Fowler and H. F. Merriam. U.S.P. 2,070,256, 9.2.37. Preparation of sulphur-bearing mineral oils by destructive decomposition of the sludge material resulting from the treatment of light hydrocarbon oil distillate containing not less than 0·15% of sulphur with sulphuric acid.

M. H. Tuttle. U.S.P. 2,070,383, 9.2.37. Production of lubricating oil from an asphaltic-base residue by solvent extraction.

M. H. Tuttle. U.S.P. 2,070,384–2,070,385, 9.2.37. Solvent refining of lubricating oil using propane and cresylic acid.

C. E. Adams. U.S.P. 2,070,567, 16.2.37. Solvent refining of hydrocarbon oil using propane.

B. H. Shoemaker. U.S.P. 2,070,626, 16.2.37. Reclaiming used crankcase lubricating oils by treatment with propane and then with clay.

B. H. Shoemaker. U.S.P. 2,070,627, 16.2.37. Refining of lubricating oil by oxidation in the presence of catalysts, *e.g.* hydroxide or carbonate of alkaline or alkaline earth metals.

C. Winning and S. C. Fulton. U.S.P. 2,071,481, 23.2.37. Preparation of dyed lubricating oils by extracting distillate residues from the cracking of petroleum with a solvent in which the asphaltenes are substantially insoluble, acid-treating the solvent extract and neutralizing.

H. Hartmann and H. Rabe. U.S.P. 2,071,521, 23.2.37. Production of fluorescent substances soluble in hydrocarbon oils by condensation of liquid olefines using a condensing agent of the Friedel Crafts type. W. S. E. C.

Asphalt and Bitumen.

559. Improved Seal Coat Materials Provide Better Bituminous Road Surfacings. J. N. Westsmith. *Nat. Petr. News*, 3.2.37, **29** (5), 73.—Road surfacing and maintenance in the State of Wyoming are discussed. Cut-backs are used almost exclusively. All roads are seal-coated as soon as consolidation is complete and, in all, 2245 miles of road have been so treated without the application of a stone cover. The re-tread process is applied extensively, but where sub-grade failure is the fault, the old surface is removed, remixed and replaced after consolidation of the sub-grade. Thin areas and shallow depressions are built up by successive treatments with a cut-back of the RC type and blinding with crushed aggregate. Great success has attended the use of a recently developed bitumen base of rather unusual properties, viz. ductility 100 plus, penetration 20–40. H. G.

560. Patents on Asphalt. J. A. Montgomerie and P. K. Archibald. E.P. 459,957, 19.1.37. Preparation of road surfacing material by mixing a mineral aggregate and creosote oil and then blending the mixture with cold asphalt, tar or pitch.

J. K. Hunt and J. H. Shipp. U.S.P. 2,069,314, 2.2.37. Manufacture of bituminous compositions by heating an asphaltite, *e.g.* gilsonite, grahamite, at 698–752° F.

E. O. Rhodes and H. E. Gillander, Jr. U.S.P. 2,069,927, 9.2.37, and J. H. Swanberg. U.S.P. 2,069,929, 9.2.37. Preparation of fluxed or cut-back tar products.

C. S. Reeve. U.S.P. 2,070,961, 16.2.37. Production of pitch by heating tars under pressure at 650° F. W. S. E. C.

Special Products.

561. Works Experience with Mineral Oils with Particular Consideration of Ageing Processes. H. Stäger. *Petr. Zeit.*, 17.2.37, **33** (7), 1.—This article deals with a lecture delivered by the author to the Austrian Petroleum Institute.

After giving general remarks on ageing, on the effects of oxygen from the air and of increasing temperature, Stäger deals with ageing conditions in transformer, switch, cable and condenser oils. Interesting experiments are described on film formation on metal boundary surfaces with the aid of a glass segment disc; these serve to show the influence of the bearing metal on the tenacity of the film. Explanations are given for rust formations and methods of prevention, and the relation shown between the stability of oil–water emulsions and the ageing condition of the oil. Finally, the occurrence of salt-like deposits in fuel oils used in firing high-pressure boilers is discussed. Several illustrations and tables are given, also data relating to the phenomena described. W. S. E. C.

562. Commercial Vegetable Waxes. F. N. Howes. *Chem. Trade J.*, 29.1.37, **100**, 91.—In spite of widespread occurrence, few vegetable waxes are of commercial importance. The most important are carnauba, candelilla, esparto and "Japan" waxes, although the last-mentioned is not a true wax. Vegetable waxes are mainly utilized in the preparation of polishes, but limited amounts are used in the manufacture of certain types of candles, varnishes, cable coverings and electrical insulators, sealing and dental wax, gramophone records, carbon papers, photographic plates, and as a substitute for beeswax in certain pharmaceutical and other preparations. The value of such waxes lies largely in the fact that addition of small quantities to softer waxes may cause a marked rise in m.p. of the resulting mixture. The true waxes are to be found among plants as a thin surface covering on some particular organ or organs, such as leaves and fruits. They are a combination of fatty acids with certain monohydric alcohols.

The origins, methods of manufacture, principal properties and principal applications of the following waxes are detailed: ceroxylon, carnauba, candelilla, flax, myrtle, raffia, "Japan," sugar-cane and fibre or esparto. R. A. E.

563. Preparation of Phenol and Cresol from Petrol. V. Cerchez and A. Schuper. *Mon. Petr. Roum.*, 1937, **38**, 97–100.—A brief survey of synthetic products from petroleum is followed by an account of the preparation of phenol and cresol from appropriate cuts from an Arbanași crude. Especial attention is given to the determination of the ideal conditions for obtaining benzene and toluene sulphonic acids. Sulphonation with very hot or with fuming sulphuric acid yields an impure product. The best method is stated to be treatment at 50° C. with concentrated acid and with continuous stirring for 8 hours. A table is given showing that the biggest yield of sulphonic acids is obtained when the petroleum/sulphuric acid ratio by weight is 420 : 184. Experimental data are given for the preparation of the calcium sulphonate and its conversion into the sodium salt. Sodium hydroxide is used for the preparation of phenol from the sodium benzene sulphonate. The cresol is prepared from the toluene fraction by a slight variation of the above method. T. C. G. T.

Detonation and Engines.

564. Some Problems of Modern High-Duty Aero Engines and their Fuels. F. R. Banks. *J.I.P.T.*, 1937, **23**, 63–177.—A comprehensive lecture with extensive discussion on aviation gasoline and aero engines under the sectional headings, present fuel position, fuel rating and correlation, and engine development which includes cylinder head and combustion-chamber design, valves, exhaust pipes and collector rings, sparking-plugs, cold corrosion, light alloy fuel tanks and leaded fuel, maximum power production, minimum fuel consumption and air versus liquid cooling. G. R. N.

565. Methods for the Determination of Knock-Ratings in Gasoline Engines. J. G. Moxey. *Nat. Petr. News*, 27.1.37, **29** (4), 60.—The "motor" method for knock-rating determinations was the outcome of the 1934 Uniontown road tests. Since 1934, however, both fuels and engines have made such advances that correlation between road tests and engine tests is again unreliable. The method is again under review with a view to further modification. The present article discusses the theories

concerning the mechanism of detonation and outlines, in some detail, the present C.F.R. Motor Method. H. G.

566. Mixture Strength in Petrol Engines Continuously Controlled by Electric Exhaust Gas Analysers. G. D. Boerlage and L. A. Peletier. *J. Roy. Aer. Soc.*, 1936, **40**, 799–814.—The paper describes an investigation of the characteristics of the "Cambridge (NY) Aero Mixture Indicator" and the "Lantz-Phelps Motor Fuel Combustion Tester." Both these instruments operate by measuring the thermal conductivity of the exhaust gas. This is done by comparing the electrical resistance of wires surrounded by exhaust gas and by a standard gas (*e.g.* air saturated with water vapour). A change in the thermal conductivity of the surrounding gas allows a change in the temperature of the wires, thus altering their resistance. As the wires are incorporated in a Wheatstone bridge, a change of resistance in a wire unbalances the bridge. The article explains how other factors affecting the temperature of the wires are overcome. It is pointed out that of the normal constituents of exhaust gas, only CO_2 and H_2 show any marked difference in thermal conductivity (*i.e.* where air = 100, CO_2 = 62 and H_2 = 715), thus the instruments are virtually CO_2 and H_2 rather than CO recorders.

Engine tests were carried out showing that change of gas pressure had only a temporary effect on the instrument, that changes of the fuel/air ratio were recorded within one minute, that the short-circuiting of a spark plug only affected the instrument when running on a rich mixture, and that the influence of detonation was not appreciable. It is pointed out that as the instruments react to CO_2 and H_2 they must be dependent on the H/C ratio of the fuel. In the investigation of this aspect a great deal of work has been carried out using a Ford V8 engine. In addition to the recordings of the instruments under test, the fuel consumption, air consumption, power output and exhaust gas temperature have been obtained at different mixture settings and upon four aviation fuels, one of which contained 30% benzene. The recordings have been expressed in several curves. In the case of the Cambridge instrument, which has been calibrated in fuel/air ratio for an average value H/C ratio, a fuel of lower H/C ratio is indicated too lean, whilst a fuel of higher H/C ratio is indicated too rich. Thus, when the highly aromatic fuel indications are plotted against true air/fuel ratio, there is a deviation of 3·5–8%. If, however, they are plotted against air factor (*i.e.* actual fuel/air ratio over fuel/air ratio for theoretical complete combustion) this deviation is only 2–5%. As the air factor is the direct criterion of completeness of combustion, this latter fact is an advantage. T. C. G. T.

567. Detonation and Stationary Gas Waves in Petrol Engines. G. D. Boerlage, J. J. Broeze, H. van Driel and L. A. Peletier. *Engineering*, 5.3.37, **143** (3712), 254–255.—An account is given of pressure investigations carried out on an L-head single-cylinder petrol engine under severe pinking conditions. The combustion chamber was provided with nine apertures for sparking-plugs and observation points, in which pressure could be observed with a piezo-electric indicator.

It was found that even with heavy pinking in the test engine there was no indication of a local initial burst of excessive pressure rise at the point where detonation occurred. Detonation, causing a pressure disturbance, resulted in stationary waves being set up in the gas charge, the lowest frequency possible predominating. The amplitude of the pressure waves was found to depend on the severity of detonation, the shape and size of the combustion chamber, and the point of observation; the relative position of the original disturbance seemed to be unimportant.

It is stated that the distribution of the wave amplitudes may be such as to cause the highest total pressure to occur at a point different from that at which the end gas explodes, and it would appear that three typical regions must be considered: (*a*) the actual detonation corner or corners where the end gas occurs, (*b*) the corner or corners where the vibrating pressure effect occurs, and (*c*) the corner or corners where the highest heat flow occurs. J. G. W.

568. Distribution of Heat Losses in Petrol Engines. W. T. David. *Engineer*, 5.2.37, **163** (4230), 154–155.—Following from a previous paper by the author, further discussion is given on the distribution of heat losses in internal-combustion engines as obtained from the work of various investigators.

The effect of running speed is examined with the limited data available and from which it is concluded that the high observed efficiencies are obtained on account of the short time of contact between the hot flame gases and the cylinder walls during explosion and expansion. J. G. W.

569. Some Results Obtained on the Cathode Ray Engine Indicator. E. M. Dodds. *J. Roy. Aero. Soc.*, 1937, **41**, 132–139.—It has been impossible up to the present time to obtain satisfactory pressure time cards on high duty boosted aircraft engines, owing to the superposition of mechanical vibration on the pressure time diagram.

A satisfactory indicator has now been produced. This indicator employs a pressure element of the capacity type, consisting only of steel and mica which need not even be water-cooled, as the diaphragm is supported against engine pressures. This element is robust and of excellent thermal characteristics.

The paper contains photographs of diagrams obtained on the Series 30 engine at 8 to 1 compression ratio running at 960 r.p.m. The diagrams indicate rate of change of pressure against time and the normal pressure time diagrams, with and without knock.

The new indicator has shown the possibility of detonation with benzole, which occurs well down the power stroke when both temperature and pressure of the gases have dropped to perhaps ¼ of their maximum value. A further application of the instrument is described, in which the degree to which a fly-wheel is running out of truth can be determined by means of the indicator. Various other applications are mentioned, *i.e.* extent and period of opening of the valves in the cylinder head. The type of diagram obtained shows up valve bounce immediately.

The paper contains the suggestion that the C.F.R. engine technique might be varied so that separate sets of conditions would be chosen, each to correspond with a given aero engine under each set of normal running conditions. Thus it might be possible to choose C.F.R. conditions to correlate with liquid cooled engines at cruising power, and another set of conditions to reproduce tests at take-off power, and similarly for air-cooled engines.

It has been possible to indicate knock on the Bristol aero engine by forcing the insulated lead, which normally connects with the pressure element, between the upper cooling fins of a cylinder, thus, since a time base is not really necessary, it is possible to pick up the onset of detonation without having to use a pressure element screwed into the head.

The possibility of providing a simplified, compact and light-weight model of the instrument, involving a miniature cathode-ray tube, which could be fitted in the cockpit of an aeroplane, is foreshadowed. W. E. J. B.

570. Influence of Humidity on Knock Ratings. J. R. MacGregor. *Oil & Gas J.*, 28.1.37, **35** (37), 164.—With the best available control of all known variables and using the bracketing system of reference fuels, variations in results on the same fuel, but tested in different laboratories, or even in the same laboratory at different times, continue to attract attention. In general, this difference has been most pronounced when rating fuels of widely different characteristics, and indicated the influence of some atmospheric variable on the combustion of the fuel. Investigations have therefore been made to ascertain the effect of variations in the water vapour present in the air. The most convenient and significant method of expressing humidity for this purpose was considered to be in lb. of water per lb. of dry air. A special hygrometer was designed to indicate the humidity of the air entering the carburettor, ensuring that water fed to the wick surrounding the wet bulb is cooled to a temperature indicated by the wet bulb before actually contacting that instrument.

A special experimental drier used to obtain humidities lower than those prevailing in the laboratory is described and illustrated. A humidifier was also utilized. The bouncing-pin was used as the best available means of measuring the intensity of detonation. In order to convert knock-meter indications to equivalent octane numbers, two reference fuel blends differing in octane number by a known small amount were used in each group of tests. Two or more fuels of the following types were used in each of the tests: straight-run, benzol/straight-run blend, cracked, leaded straight-run and octane–heptane blend. Fuels of 42, 68, 73 and 88 octane number were examined in the various series of tests. Differences in the response

of fuel types to humidity are not in exact agreement in each series, but leaded fuels show the greatest response to change in humidity, especially in the highest octane number series. The differences are probably due to slight inaccuracies in mixing the reference fuel blends. In the 68 octane-number series, the changes in absolute knock, in terms of equivalent octane numbers, for changes in humidity from 0·002 to 0·023 lb. of water per lb. of dry air (equivalent to a change in water vapour pressure of 1 in. of Hg) were :—

for octane — heptane	5·1
C9 — A4 blend	7·2
C9 — A4 plus TEL	10·8
Cracked spirit	7·9
Straight-run benzole blend	7·9

Tests carried out by throttling the intake air and keeping the humidity constant show that the leaded reference fuel was least affected under these conditions. Dry air-pressure change alone, therefore, does not explain the effect of humidity on detonation, so that correcting for humidity on the basis of dry-air pressure alone will not eliminate necessity for humidity control. Calibrations of a leaded straight-run reference fuel were made at varying controlled humidities ranging from 0·004 to 0·036 lb. of water per lb. of dry air, and show differences of as much as 2 octane numbers with 2·4 ml. T.E.L. per gal. This observation explains changes in calibration curves which have been observed from time to time in the past. The average humidity prevailing in the various laboratories participating at the time when the C.F.R. motor method was established is estimated to be 0·0135 lb. of water per lb. of dry air. All knock ratings in the Standard Oil Co. of California laboratory are carried out at this standard humidity. R. A. E.

571. **Piston Temperatures in a Sleeve Valve Oil Engine.** H. Wright Baker. *Engineering*, 22.1.37, **143** (3706), 107–108; 5.2.37, **143** (3708), 164–165.—The engine used for the tests described was a three-cylinder Mirrlees–Ricardo which could be run at speeds up to 1400 R.P.M. Three pistons of different construction and composition were examined by means of built-in thermocouples. The leads were taken away by means of a system of links, arranged so that the minimum of flexing occurred at the pivots; where flexing occurred, short inserts of clock spring were used in the connections. It was found that this arrangement would run almost indefinitely without failure.

The thermocouples were copper and eureka, and in some cases eureka and the metal of the piston; with the latter arrangement it was possible to record a larger number of points at the same time. It is believed that the accuracy of the temperature records is of a reasonably high order.

Curves are given showing the effect of the following variables on the temperature of the pistons at various points: B.H.P., injection timing, running speed and water outlet temperature. An estimation is made of the rate of heat flow to the piston and the effect of turbulence is discussed.

Some comparative figures from other investigators are given. J. G. W.

572. **Junkers Heavy-Oil Aero-Engines.** J. Gasterstaedt. *Engineer*, 5.2.37, **163** (4230), 167–170.—The development of the Junkers opposed piston oil engines for aircraft is described. Details are given of the various features in the design of the "Jumo" series of engines, which contribute to the high performance and low specific fuel consumption that are obtainable. The problems associated with: maximum pressure; vibration, scavenging and supercharging; fuel injection; and heat dissipation are discussed in detail.

The utilization of part of the energy of the exhaust gases by turbo-blowers is described.

The author contemplates an engine of 1500–2000 B.H.P. at a specific weight of less than 1·1 lb. per horse-power. The six-cylinder in-line construction would be abandoned in favour of a four crank-shaft engine, which, in addition to giving a gain in efficiency and a reduction in weight, would give a saving in space.

The author is confident that the oil engine, by reason of its advantages in service and the safety of its fuel, will be used in air traffic to an ever-increasing extent. J. G. W.

573. Diesel Engines, their Fuels and Comparative Efficiencies. A. L. Foster. *Nat. Petr. News*, 27.1.37, **29** (4), 57.—The article discusses papers read at the S.A.E. meeting at Detroit. It appears that no agreement has been reached as to whether diesel fuel shall be produced to suit particular engines, whatever these may be in the future, or engines designed to take advantage of the economy offered by a large range of low-priced fuels. A strong plea is made for active co-operation between refiners and engine designers to ensure the full utilization of the resources of each and the early standardization of fuel. In comparing the relative costs of different methods of long-distance transport, it is found that gasoline-engined trucks have the advantage over railways up to 200 miles and over water transport up to 365 miles. Diesel-engined trucks are cheaper than the railway up to 435 miles between points on a railway and up to 1000 miles between points off the railway. Water transport is the cheapest form of transport for distances above 520 miles. 20-ton loads are considered for purposes of the comparison. Where diesel fuel bears no tax, the saving in fuel costs compared with gasoline engine fuel costs is over 80%. H. G.

574. The Applicability of Laboratory Methods for the Determination of the Ignition Quality of Diesel Fuels. R. Heinze and H. Hopf. *Brennstoff-Chemie*, 1936, **17**, 441–445.—The relationships of the results afforded by various laboratory methods proposed for the determination of the ignition quality of diesel fuels to cetene rating determined in the C.F.R. unit were traced for fuels from a wide range of sources; and expressed graphically as simple curves. The closeness of the relationship decreased in the order, specific parachor, specific gravity, diesel index and viscosity gravity constant. The best correlations were obtained between parachor and cetene number and sp. gr./20° C. and cetene number; when regard was also given to the 50% boiling point. B. C. A.

Coal and Shale.

575. Development of Bituminous Shale Industry. I. Ganitzki. *Mon. Petr. Roum.*, 1936, **37**, 1519–1521.—The article briefly surveys the development of the shale industry in Russia. Known in the eighteenth century, the shale deposits were not worked in Esthonia till 1916 or in Russia till 1919. The shale contains about 75% ash. The spirit from the shale has a high octane number, and the residual oil is heavier than water. The Esthonian deposits, from which four plants in 1935 produced 604,000 tonnes, stretch into Russia towards Leningrad. Russia produced 4535 tonnes in 1919, rising to 193,000 tonnes in 1932, and estimated at 2,600,000 tonnes for 1937. Of the 1937 figures, the Gdov mines (Leningrad region), 750,000 tonnes; Savelievski mines (Saratov region), 150,000 tonnes; and the Tchiouwachi region, 1,100,000 tonnes, are the main producers.

95,000,000 roubles will have been invested in the industry between 1933 and 1937. This is apportioned as follows: to Gdov for development of three new mines each with a capacity of 600,000 tonnes per year, 43,000,000; to Savelievski, one mine producing to capacity 500,000 tonnes and another under development, 19,000,000; and to the development of the Kapchyra and Obchty Sirt 33,000,000. A further 45,000,000 will be provided for 1938 and 1939.

The Gdov and Esthonian deposits are of the Silurian age, while the Tchiouwachi are Jurassic. The reserves of the Obchty Sirt field alone are estimated at 1,245,000,000 tonnes, and many more untouched shale deposits are known in Asiatic Russia. The shale yields numerous products from pharmaceutical to petrol and crude tars. In the Gdov region the tars are converted to gas, and pipe-lines supply this to Leningrad. Improved combustion technique permits the use of shale in the boilers of the big electrical power plants of the Saratov region.

Among several problems of the shale industry, Russian technicians are investigating the possible utilization of the peat and the saprophagous muds which appear to occur in the proximity of shale deposits. T. C. G. T.

576. Oil Shales Gaining Commercial Importance in Central Europe. M. Raud. *Oil & Gas J.*, 25.2.37, **35** (41), 66.—The Esthonian shale beds extend over an area of 3000 sq. kilometres and are calculated to contain between 4½ and 6 million tons of

shale. Commercial production commenced in 1918, and by the end of 1935 the total production was 6,005,090 tons, the present annual production being 600,000 tons. Five companies operate in Esthonia, 350,000 tons of shale being burnt as fuel by railways and factories, while 250,000 tons pass to the distillation units, where 47,000 tons of crude oil are produced. Utilization of the shale direct as fuel is limited by its high ash content and high ratio of weight to calorific value. The stills used include the vertical type with inside firing (Pintsch), the tunnel type with outside firing and the rotary cylindrical furnace (Davidson) producing 18–21% of crude oil from the fresh shale in its moist state. Shale tar from the crude is used for coating and impregnating railroad ties, telegraph poles, etc., for street surfacing, for roofing and insulating products. Other products are used as boiler and I.C. engine fuel. The gasoline produced has a high anti-knock value and finds a ready market. The exportation of shale oil and derivatives to the Baltic States and other countries is increasing.

C. L. G.

577. South African Torbanite and Refining. Anon. *Petr. Times*, 30.1.37, **37** (942), 149.—The estimated amount of torbanite at the Mooifontein farm is 5,200,000 tons, with an oil content of 43 gallons per ton. 400,000 gallons of torbanite crude oil has been produced up to date. Gasoline production has now reached 92% of the quota fixed by the terms of the agreement with the S.A. Government, whereby gasoline from torbanite enjoys the advantages of a preferential tariff. H. G.

Economics and Statistics.

578. World Crude-oil Production. H. S. Norman. *Oil & Gas J.*, 28.1.37, **35** (37), 152.—The estimated crude production for 1936 is 1,779,767,000 brls., an increase of 135,590,000 brls. over 1935, equivalent to 8·24%. Of this amount the U.S.A. was responsible for 1,089,014,000 brls., an increase of 9·93% over 1935. An increased production was obtained in all the principal producing countries except Poland and Egypt. Production in Venezuela would doubtless have been higher but for labour troubles. Reference is made to marked increases in production of Iran, Bahrein Island, Trinidad and Argentina and the causes discussed. Increased drilling activity is expected during 1937 in the D.E.I. R. A. E.

579. Treatment of Crude Petroleum. I. Ganitzki. *Mon. Petr. Roum.*, 1937, **38**, 103–106.—No concentrated effort was made to organize the petroleum industry in Russia until about 1921. Production of crude reached a minimum in the year 1920–21, while in 1918 only 35% of the production was processed. From 1921 to 1928 efforts were made to modernize existing plant, and over this period about 70% of the production was treated. The period 1928–32 saw the introduction of pipe stills; of the 33 topping plants constructed in this time, 26 were pipe-stills, and 88% of the production was processed. Very little plant construction occurred in 1933 and 1934, but there has since been a revival in this sphere. In the period 1933–36 production has tended to gain slightly upon the refineries, but the indications are that this tendency has been corrected in 1936, when it is expected that 95% of the crude will be handled.

Various tables are given illustrating the increase in production and treatment of crude over the periods mentioned, thus in the eight years 1920–28 about 57 million tonnes were produced and 70% processed; from 1928 to 1932 80 million tonnes produced and 88% processed, while from 1933 to 1936 inclusive the figures are 99 million tonnes produced and 86% processed. The annual capacity of topping plants has risen from 6 million tonnes in 1924 to 28 million in 1936, while estimated construction will bring this figure to 36 millions in 1937. T. C. G. T.

580. Petroleum in the British Empire. Anon. *Rev. Petr.*, 13.2.37 (722), 217–18; 27.2.37 (724), 281–20.—**Australia.** Here it is suggested that the Government should subsidize geological search rather than shale-oil cracking and hydrogenation.

Canada. With recent discoveries Turner Valley may be considered a real oilfield. The east flank apparently contains little oil, but recently on the west flank several 600 to 800-barrel wells at 6000 ft. have been completed. However, these may not

"prove" a large area, and the previous waste of gas has diminished the reservoir pressure, and it may be necessary to adopt repressuring.

Trinidad. During 1936 prosperity returned to Trinidad, as evinced by the numerous exploration licences applied for. On the fields deep synclinal drilling is now prevalent.
R. O. Y.

581. American Company Obtains Large Concessions in Iran and Afghanistan. Anon. *Rev. Petr.*, 6.2.37 (721), 173–4; 20.2.37 (723), 238–240.—The recipient of these concessions is the Amiranian Oil Co. The Afghan concession covers the whole of Afghanistan, while the Iranian covers all Iran E. of a line, Bandare Chah, on the Caspian Sea, to Irafshan near the S. coast of Iran. R. O. Y.

582. Oil Industry in Russia. New Areas in 1937. I. Ganitzki. *Mon. Petr. Roum.*, 1936, **37**, 1661–1664.—Following a study of American fields in 1936, a decree ordered wide exploration of new fields, resumption of work on wells, and fields closed on account of poor results, changes in administration, and centralized repair workshops.

The trusts were reorganized thus: (*a*) Vostocneft was divided into (1) Bachneft, with refineries at Oufa and headquarters at Sterlitamak, and (2) New Vostocneft, with refineries at T. Gorodki and headquarters at Syzran. The districts of Syzran and Samarskaia Luca on the right bank of the Volga, as well as the banks of the tributary Sok on the left bank, are oilfields. Two wells near Suzran gave 20 metric tons of very light oil in May 1936. They have been drilled to 610 metres.

(*b*) The Azneft trust was split into four.

(*c*) Sredazneft trust, with two big areas, has its headquarters for the Fergana valley at Kokand, and for the Bokhara field at Termez.

(*d*) Grozneft trust has three centres, viz. Groznyi, Malgobek, Izerbach.

All the western shore of the Caspian from Makhatchi to Azerbaijan is rich in oil, but the richest levels are under the sea. Drilling at Izerbach began in 1924. In 1936 a well 1646 metres deep gushed, giving an oil with 59% light fractions. Depth corresponds to horizon 16 at Groznyi. The middle part of the Izerbach region has 18 oil-bearing horizons between 610 and 1450 m. A further 12 horizons have been found deeper than 1525 m.

In this and the two neighbouring fields some wells are sloped so as to pass under the sea. The Kertchi peninsula has been taken over by the Krimgazneft trust. Oil was found in small amounts before the War, but in October 1936 deep drilling gave a gusher of very light oil and gas.

Altogether there are now 17 trusts. New fields to be opened in 1937 are

(1) Chongar, Kyziltepe and Kergez in Kabristan.

(2) Pirsagat, 80 km. south-west of Baku, from which 500,000 metric tons of crude oil are expected in 1937.

(3) Four fields in Daghestan already proved at Izerbach, etc. Expectation 1 million tons.

(4) A field at Kouseapkoulovo by the Bachneft trust mentioned above. With this and extensions at Ichimbaevo, the trust expects 1,700,000 tons in 1937.

(5) Fields at Haoudag and Outchi-Kyzil in the south of Ouzbekistan.

(6) A field at Crasnokamsk, 40 km. west of Perm. Oil has now been found 80 km. east of Perm, 40 km. west and 20 km. south, as well as round Sterlitamak 200 km. south. It seems that all the area between the western Urals and the lower course of the Volga contains oil in the upper palæozoic.

14 new fields will be in production in 1937, and in 20 more the explorations will be finished. In 32 areas exploration will be begun or intensified. W. E. J. B.

583. 1936 Consumption of Oil Products. V. R. Garfias and E. V. Whetsel. *Nat. Petr. News*, 24.2.37, **29** (8), 97.—It is estimated that the world consumption of petroleum, its products and related fuels during 1936 was 1,757,778,000 brls., an increase of 143,000,000 brls. over 1935. These figures represent an excess over demand of 92,510,000 and 88,000,000 brls. respectively. Stocks in the U.S.A. decreased by 23,400,000 brls., compared with 22,447,000 brls. in 1935. Outside the U.S.A. the excess of consumption over production was 116,000,000 brls., but a large proportion

of this represents an increase in stocks. The latter fact indicates that the favourable export balance of the U.S.A. will be reduced when stocks have reached a satisfactory limit. Tables give the classified consumption of petroleum products in the principal countries of the world. H. G.

584. Lack of Discoveries Calls for more Wildcatting on Rumanian Prospects. Anon. *Oil Weekly*, 22.2.37, **84** (11), 126, 128, 130.—The year's exploratory efforts are reviewed, these having been very disappointing. The only favourable development is the discovery of Meotic gas and Miocene oil at Margineni. Calinești failed to develop as an E. extension of the Moreni district. Bucșani was also disappointing; proration accomplished little in attempting to arrest the rapid pressure and production decline. The first deep well drilled S. of Ploești failed to find oil, but proved the existence of sands in the Meotic. The producers' handicaps and legal hindrances to exploration are referred to, and production figures presented. A. J. H.

585. Fuel Technology in Japan. Anon. *J. Fuel Soc. Japan*, 1937, **16** (172), 7–13.—A précis of the annual review of fuel technology in Japan during 1936 under the headings coal-mining industry, studies in petroleum hydrocarbons, hydrogenation industry, studies on hydrogenation, studies on gasoline synthesis, low-temperature carbonization, the gas industry, gas polymerization and lubricating oils. G. R. N.

586. Wave of Activity Should Yield Results Important to New Guinea. D. D. Condit. *Oil Weekly*, 22.2.37, **84** (11), 178–182.—This article reviews the history of oil exploration in New Guinea and Papua. Until 1920 drilling was confined to seepage areas, notably to Upoia on the Valaila river, where a little oil was found, though not in commercial quantities. A well was started in 1922 to test the Popo anticline, a structure which had not been recognized when the Popo gas blows were originally discovered. Drilling met with great difficulties, and the testing of Popo was never brought to a conclusion. Other test wells are mentioned in the Oriomo river and Marienburg areas, where results were disappointing. A. J. H.

587. California's Old Fields are Important Reserves. B. Mills. *Oil Weekly*, 15.2.37, **84** (10), 39–40, 42.—The major settled fields offer the most hope for deeper production in California, and the possibilities of a number of the more important of these fields are discussed. It is indicated that hopes for production are only limited by the basement complex, which has not yet been closely approached. The deeper formations may not be so productive, as they usually become tighter with depth, but high gas pressures will probably counteract this feature, and high gas–oil ratios may be expected. A. J. H.

BOOKS RECEIVED.

APPLIED CHEMISTRY FOR ENGINEERS. A. F. H. Ward. Pp. xi + 127. 1936, Longmans Green & Co., London, E.C.4.

This little book is intended to provide a practical course in applied chemistry for students in technical colleges and universities, and for students of pure chemistry needing an introduction to applied chemistry.

THERMO-DYNAMICS. Stanton E. Winston. Pp. 178. 1937, American Technical Society, Chicago, U.S.A.

A practical text-book to cover the fundamentals of thermodynamics basic to the engineering field. The intention of this book is to be as simple in manner as possible on the more general principles of thermodynamics. Illustrated.

IRON AND STEEL INSTITUTE, JOURNAL II, 1936, Vol. 134. PROCEEDINGS pp. 1 F–649 F, ABSTRACTS AND BIBLIOGRAPHY pp. 1 A–283 A, INDICES pp. 1–59. Iron and Steel Institute, 28 Victoria St., London, S.W.1.

The first section embraces the Minutes of Proceedings, including 15 papers presented at the Autumn Meeting held in Dusseldorf on 21st and 26th Sept., 1936, together with Special Reports Nos. 13, 14, 15 of the Corrosion Committee, Alloy Steels Research Committee and Steel Castings Research Committee, respectively. The second section consists of Abstracts and Reviews on iron, steel and kindred subjects.

NEW ZEALAND OFFICIAL YEAR BOOK, 1937, pp. 894. 1936, Govt. Printer, Wellington. 7*s*. 6*d*.

The forty-fifth issue of this Year Book has been further expanded. Certain subjects, such as the section on Labour Laws, needed a broader treatment, and new sections have been added, such as one on Broadcasting and one on Consumption of Commodities, under which section the consumption of petrol for 1935 at 68,229,000 gals. is shown as having increased by 11,567,000 gals. in two years. No drilling for petroleum was done in 1935. During the year a production of 185,784 gals. of oil was obtained from Moturoa Wells, 1, 2 and 4 at New Plymouth, and 312 gals. at Kotuku from seepages. Total production to 31st December, 1935, is estimated at 2,409,258 gals. The Government has given liberal bonuses, subsidies and loans to oil-prospecting operations in the Dominion. Legislation with regard to prospecting for and winning of petroleum is under review.

AMERICAN ACADEMY OF ARTS AND SCIENCES: PROCEEDINGS. 1937. Vol. 71, Nos. 6, 7, and 8 and Vol. 71, No. 9 (in 2 covers). Pp. 327–385 and pp. 387–460. Jan. 1937. Am. Acad. As. and Scs., 28 Newbury St., Boston, Mass., each cover $1.20.

The first of these covers contains three papers on "An Experimental Study of the Absolute Temperature Scale," by J. A. Beattie, B. E. Blaisdell, M. Benedict and J. Kaminsky. The second cover contains a paper on "Shearing Phenomena at High Pressures, particularly in Inorganic Compounds," by P. W. Bridgeman.

CANADA. DEPARTMENT OF MINES AND RESOURCES. MINES AND GEOLOGY BRANCH, BUREAU OF MINES. BULL. 277. FUEL BRIQUETTING. 1937. R. A. Strong, E. Swartzman and E. J. Burrough. v + 120 pp. 1937, King's Printer, Ottawa. 25 cents.

This Report is an account of the fuel briquetting industry for the benefit of those interested in its history, its present status and the possibilities of fuel briquetting in Canada. The industry has attained importance in several countries of Europe, but has been of slight interest to North America. This is due to difference of markets, as the standards and specifications for domestic fuel differ considerably from those for industrial fuel.

The six chapters are devoted to the History, Processes for Briquetting Various Classes of Fuels, Binders for Briquettes, Equipment Used in Briquetting, Investigation on Briquetting in North America and Economics of Briquetting. The Bulletin is completed by a Foreword, an Introduction, 13 Tables, a Bibliographical Reference List, an Appendix-Review of Patent Literature on Binders and Index. 5 photo plates and 2 drawings.

ANNUAL REPORTS OF THE SOCIETY OF CHEMICAL INDUSTRY ON THE PROGRESS OF APPLIED CHEMISTRY. Vol. XXI, 1936, London. The Society of Chemical Industry, pp. 869. 12*s.* 6*d.* (7*s.* 6*d.* to members of the Society of Chemical Industry).

This volume equally merits Colonel Auld's well-expressed eulogy bestowed on its predecessor in his review of last year. There are 65 pp. more in the 1936 issue, which are nearly accounted for by a Report on Explosives by John Weir, an addition to the 25 subjects dealt with in both volumes, XX and XXI.

Mr. Goulston follows up his previous year's good work, again starting on Corrosion (nearly 2 pp. of interesting investigative information and comment) in a Report of some 25 pp.: he covers in addition the subjects of Crude Oils, Petroleum Substitutes, Natural Gas, Carbon Black, Refinery Plant, General Refining, Motor Spirit, Lubricating Oils, Paraffin Wax, Fuel Oil, Asphaltic Bitumen, Pyrolysis and Polymerization of Gases, Analysis and Testing, Special Products and finally Chemical Derivatives of Petroleum. His bibliographical references number 109.

The bibliographical references for the whole volume, covering recent literature, should be of great value to readers. They range from 42 to 332 references per Report, and are separated into a Name and Subject Index, at the end of the book.

U.S. Geological Survey:

BULL. 873. GEOLOGY AND MINERAL RESOURCES OF THE BUTLER AND ZELIENOPLE QUADRANGLES, PENNSYLVANIA. G. B. Richardson. Pp. v + 93. 1936, Superintendent of Documents, Washington, D.C. 45 cents.

This Report is one of a series of publications on the geology and mineral resources of the Appalachian Plateau. The Butler and Zelienople Quadrangles, including together about 450 square miles, have varied mineral resources, the outcropping beds containing limestone, sandstone and shale, and also extensive deposits of clay. Before Lake Superior ore was available, iron ore was mined here, but the principal mineral resources are coal, oil and gas. Valuable highly volatile bituminous coals underlie the quadrangles, but thicker beds in nearby areas have limited considerably the exploitation of these coal measures here. This area is within the northern Appalachian oil and gas region, and oil sands occur in a stratigraphic interval of about 1800 ft. For 30 years, starting from 1872, the producing area was actively drilled and production was good, but for many years now the average daily production/well has been only a fraction of a brl. An interesting detailed description of the geology is given and the early drilling work and production therefrom is reviewed. The future prospects of the area in the upper sands already tested are not hopeful, but there may be value in the sands below the Fifth Sand in beds which have contained oil in other parts of the Appalachian region.

BULL. 881. SPIRIT LEVELLING IN CONNECTICUT, 1922–1935. J. G. Staack. Pp. ii + 65. 1937, Superintendent of Documents, Washington, D.C. 10 cents.

Reports an agreement for a co-operative level control survey throughout the State by the U.S. Geological Survey and the Highway Commissioner of Connecticut. The survey is described in detail. 1 plate and 1 map figure.

BULL. 886. A POSSIBILITY OF NEW OIL POOLS IN THE SILICEOUS LIME AND BARTLESVILLE SAND IN T. 23 N., R. 10 E., OSAGE COUNTY, OKLAHOMA. N. W. Bass, W. R. Dillard and J. H. Hengst. Pp. 4. 1936, Superintendent of Documents, Washington, D.C. 5 cents.

A field party of the U.S. Geological Survey has recently found many localities in the Osage Indian Reservation, worthy of prospecting for oil by a study of the sub-

surface geology of the reservation. This bulletin is in advance of the completion and publication of the Geological Surveys Report, and describes several of the typical favourable localities. Reasons for favourable opinions are given by the history of some wells drilled in the reservation. The siliceous limestone is believed to be a very promising horizon. Wells already drilled have increased their production by treatment with hydrochloric acid. In one case wells after treatment produced more oil in 1½ years than they had in 6 years operation before treatment.

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Geology.

588. Bucsani Oilfield. V. Zotinca. *Mon. Petr. Roum.*, 1937, **38**, 31–43.—This field is situated south of the Ploesti to Targoviste road in Rumania. A section through the field is given, showing the anticline, with faults on both sides. The strata have suffered intense folding, and adjacent wells often show considerable differences. Salt domes are found below the "meotic" outside each fault. Three oil-bearing layers occur in the meotic, the first productive only near the axis of the anticline (running S.W.–N.E.), the second unimportant, and the third productive everywhere.

The third layer is 10 to 12 m. thick in the west, 20 m. on the east, and tapers to the south to 3 or 4 m. Especially in the west the oil-bearing sands have layers of marl running through, but in the east they are continuous. There is much gas in the top layers, and in recent wells these are cemented off. The initial pressure at the bottom is usually high, *e.g.* 150 atmospheres in a "Romano-American" well giving much gas and an oil of density 0·73 with high spirit content. Pressure falls off quickly, showing the field to be porous, and a minimum distance of 200 m. between wells is in force.

Production details are given, showing how competition has led to higher gas ratios and a lower index of production for individual wells. Rationalization was adopted and a syndicate was formed to ration production. Its aim was to maintain gas pressure as far as possible considering the amount of oil extracted and to make better use of the gas.

The various methods adopted to carry out these aims are described, as well as the production formulæ proposed.

Among new technical methods adopted the most important are—

Robishaw drilling tools (enabling the core of sand or clay to be withdrawn without withdrawing the drill, etc.). A toothed circular drill, metallic foundations, "Moga" built-up perforators. W. E. J. B.

589. Subsurface Distribution of Hamilton Group of New York and Northern Pennsylvania. J. R. Reeves and N. C. Davies. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 311–316.—The Hamilton Group consists mainly of shales, with a few beds of limestone and sandstone. They are exposed in a narrow belt in New York and Pennsylvania in the form of a great semi-ellipse. The area within this structure is approximately 250 miles E. and W. and 125 miles N. and S., and here the Hamilton Group lies buried below younger Devonian rocks. Little was known regarding the character of the Group until 1930, when natural gas was found in the Oriskany Sandstone in Schuyler Co. (New York) and Tioga Co. (Pa.). A number of deep wells have since been made through the rocks, and from these drill cuttings have been obtained and described.

The greatest thickness of the Group (as shown on an isopach map) appears to be in the Catskill region, where it may reach 3500 ft. or more. This area probably represents the deepest part of the Devonian basin that existed during Hamilton times.

G. S. S.

590. Insoluble Residues of Dundee and Detroit River (Upper Monroe) Formations of Central Michigan. D. C. Wellman. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 317–332.—Difficulties in correlating and differentiating the Dundee and Detroit River formations have led to a study of their insoluble residues. The location of horizons within the Dundee is particularly desirable, as this formation is the chief source of petroleum in the region.

The section chosen for investigation is in the Michigan Basin province, and includes an area over 120 miles long and 60 miles wide: a district sometimes referred to as the "Central Michigan oilfields."

The technique employed in the preparation of the residues is outlined and their characteristics are described.

Among the chief facts gained from the investigation were: (1) the Dundee and Detroit River formations contain certain constituents characteristic of each formation; (2) residues from various parts of the Dundee differ, and thus enable the position of the sample in the section to be approximately determined; (3) quantitative measurement of coarse residues are valuable for correlation when complete sections are available and

when anhydrite and shale do not occur in large amounts; (4) residues supply no direct evidence of the presence or absence of an unconformity between the Dundee and Detroit River.

A map showing location of wells, etc., a generalized stratified column, and a table of characteristic residues, together with several photomicrographs, are included in the paper. G. S. S.

591. Oil Possibilities in Italian East Africa. A. Belluigi. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 293–298.—Structural conditions are not considered favourable for the accumulation of oil in Italian East Africa. Nevertheless, although no anticlinal structures or domes appear to be present, it is thought that folds and reservoir traps may be discovered where fracturing and compression may have operated in coastal zones on younger deposits of Eocene or Oligocene age.

Other possibilities of oil accumulation may occur in the rift valleys or basins of Abyssinia, provided conditions of a geosynclinal character occur. G. S. S.

592. Oil Production. E. P. Canepa. *Bol. Inform. Petroleras* (*B.A.*), Dec. 1936, **13** (148), 89–130.—After defining the essential features of an oil reservoir, the author gives a brief description of the sedimentational and diastrophic history of suitable reservoir structures, particular attention being paid to the phenomenon of compaction. Theories of migration and accumulation are then discussed. Hunt's "gravitational" theory and Munn's "hydraulic" theory are mentioned, and McCoy's "substitution" theory is described in detail, the conclusions derived by McCoy and Keyte from experiments being quoted. It is said that the occurrence of oil deposits in isolated lenticles or in calcareous beds of only local permeability can only be explained by genesis *in situ*; in most cases, however, the oil has accumulated after more or less extensive horizontal migration, whilst vertical migration along fault planes is of importance, particularly in the formation of several productive horizons.

After classifying oil reservoirs in a number of ways, on petrographical and lithological characters, on the type of porosity, on the kind of contact between the oil and the rock ("wet" or "dry" depending on the presence or absence of a water-film on the rock surfaces), on the type of structure determining accumulation, and according to Herold's conception of the type of "control," the author adopts Tickell's classification on the producing characteristics of the reservoirs.

The potential energy of each of Tickell's type reservoirs is discussed, and the energy available for production is divided into three categories, the gravitational energy of the oil itself, that of the water in contact with it, and the expansional energy of the gas contained in the oil or associated with it. The rest of the article comprises a mathematical treatment of reservoir mechanics, and the development of equations connecting the production with the expenditure of energy. A. J. H.

593. Study of Oilfields May Aid Discovery of Fresh Reserves. W. V. Howard. *Oil & Gas J.*, 11.3.37, **35** (43), 26–28.—The author divides the United States into seventeen structural units, and considers the possibilities of future discoveries in each of them and the probable type of trap. The most promising areas are considered to be the Mid-Continent, Western Gulf, and California. These three regions are thought to have favourable chances of obtaining both shore-line and unconformity production.

Of those areas which at present give little or no production the Atlantic Coast and Florida are considered to be the least attractive. All of the others are presumed to contain possibilities of stratigraphic traps which may give commercial production.

A map is given on which the known fields and possible future developments are shown. J. A. G.

594. Geology of the Ogemaw County and West Branch Oilfield. E. A. Newman. *Progress Report No. 2, Michigan Dept. of Conservation, Geol. Surv. Division*, Aug. 1936, 1–17.—This area, located on the north-eastern edge of the Michigan Basin, is covered by glacial drift varying in thickness up to 500 ft., which, to a certain extent, reflects the structure of the underlying rocks. Beneath this cover the Pennsylvanian and Mississippian outcrop successively from S.W. to N.E. In some places older beds outcrop through the younger formations, and this may indicate that they were either

laid down around the hills formed by the older rocks, or that erosion has removed the younger beds from the hill-tops. The latter explanation is favoured.

The West Branch Oilfield lies on an assymmetrical anticline trending N.W.–S.E., which dips to the N.E. at about 200 ft. per mile and S.W. at 100 ft. per mile. Production is obtained from the Traverse and Dundee Limestones of Devonian age. These beds are covered by a shale and sandstone series ranging in age from Devonian to Mississippian. Most of the production comes from the Dundee, which contains three or more oil zones with a combined thickness of about 20 ft. Accumulation in the Traverse is patchy, and probably largely controlled by the variation in texture and porosity of the limestone.

Possibilities of deeper production are considered. Two wells have been drilled below the Dundee, and the complete drilling log of one of these is given. A little oil was found in the Detroit River formation, but it is considered that a number of wells must be drilled to test this formation, the Trenton and the St. Peters. Other structures in the neighbourhood have been tested, but so far with little success.

J. A. G.

595. Geology of the South Burbank Pool. E. O. Markham and L. C. Lamar. *Oil & Gas J.*, 25.3.37. **35** (45), 64, 66, 71–72.—This area is a slightly folded monocline dipping gently south and west at about 40 ft. per mile. Production is from a sand-lens in the Cherokee Shale (Pennsylvanian) which thins out into shale eastwards.

The formation of the Mississippi Lime was preceded and succeeded by periods of intense erosion, the latter removing all evidence of structure in the Mississippian. The deposition of the Cherokee Shale followed, and in the lower part of this series the Bartlesville Sand is found in the N. and the Burbank Sand in the S. The latter varies from 0 to 100 ft. in thickness and has an average porosity of 17·0%. Overlying the Burbank is a shaly series, the transition from a porous sand to a tight sandy shale taking place in less than 5 ft., a feature which points to rapid submergence of the sand-lens, carrying it below the influence of wave action. N.–S. growth ridges developed on the sand during deposition have been well preserved, and these are reflected in the overlying Oswego Lime. Folds mapped on top of the latter formation may be due to differential compaction in the underlying sand and shale series. It is estimated that under an overburden of 3000 ft. shale would compact about 40% and sand about 5%. This difference would adequately account for the structure in the Oswego Lime.

Anomalies in the water table have been noted, but insufficient evidence is available to satisfactorily explain them.

J. A. G.

596. Geology of the Crystal Oilfield Montcalm County, Michigan. G. E. Eddy. *Progress Report No.* 1, *Michigan Dept. of Conservation Geol. Surv. Division*, July 1936, 1–8.—The Crystal field is situated on one of the principal N.W.–S.E. structural trends in the Michigan Basin, and is bounded on the east and west by two hill ranges of glacial origin.

Production is from the Dundee and Detroit River Limestones, which are overlain by the Bell Shale. The local structure is a flat-topped anticline with the steeper dip on the N.E. basinwards side and a gently dipping S.W. flank.

The deposition of the Dundee Limestone was followed by a period of intense erosion which removed most of the latter and developed secondary porosity to a depth of 200 ft. in the Detroit River Limestone. The Bell Shale was deposited over this old land surface, and the structures in the overlying beds are believed to be due to slumping and subsequent folding along these zones of weakness.

The field was discovered early in 1935, and has an average daily yield of 8100 brls. Production is patchy, and there is very little gas pressure, water drive being the main source of energy.

J. A. G.

597. Geology of the Coast of the State of Alagoas, Brazil. V. Oppenheim. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 299–310.—This paper constitutes a general survey of the State of Alagoas, a part of which has been published in Portuguese.*

* "Possibilidades da existencia de petroleo em Alagoas," *Min. e Metall.* (*Rio de Janeiro*), Vol. 1, No. 1 (May–June 1936), pp. 26–32).

Three topographical divisions occur: a hilly Archean area, coastal sedimentary plain, and the coast itself. These are well defined and geologically distinct. The Archean covers most of the State in the west, north and south, but is bordered on the east and south-east by sedimentary rocks.

The Archean rocks are mainly granites and gneisses. The sedimentary series (Barreiras formation) forms a belt 20–30 kil. wide along the coast. The upper portion consists of sandstones, clays and shales; and, although unfossiliferous, is proved by lithological correlation to be Tertiary. The lower portion, consisting of shales and thin limestones of the Alagoas Series, is fossiliferous, and has been classified as Eocene. The rocks are impregnated with asphalt, which is stated to be the result of local metamorphism. They are the only known sediments considered as possibly oil-bearing.

The Alagoas Series suggest several structural elevations of which the outcrops are the summits, and show effects of much erosion which preceded the deposition of the Barreiras formation. The dip of the beds is westerly, and this, when considered in conjunction with the extent of the belt, confirms the evidence of thinning beds and limitation of the basin to the north.

From a study of the outcrops and logs of wells in the Riacho Doce area, the existence of oil in the Alagoas Series is considered a possibility; although the general conditions for the development of important production are unfavourable. The writer concludes a deep test well is desirable and recommends a geophysical survey; this is now being made. G. S. S.

598. Some Dip Problems. D. J. Fisher. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 340–351.—The history of the solution of dip problems is described briefly. It is possible to prepare a straight-line graph for solving apparent versus true dip problems for small angles. The deviations of values obtained by this approximate method from the true values, are examined, and it is shown that this graph can be used up to dips of 15° with a good degree of accuracy.

A "minimum scale-error" chart is given whereby the slope distance can be read off when the angle of slope and the horizontal distance are known.

A graphical solution for determining the direction and inclination of the axis of a plunging anticline, from the true dips of its flanks, is given, as well as a graphical method of determining the original dip of the lower of two sets of dipping beds, separated by an angular unconformity, assuming that the upper beds were deposited horizontally. G. D. H.

Geophysics.

599. Interpretation of Geophysical Data. L. W. Blau. *Oil Weekly*, 29.3.37, **85** (3), 23–28.—Should the interpretation of geophysical data be independent of geology or coloured by what is known or surmised of the geology of the area investigated?

Geophysical measurements yield no direct geological information, but lead the geophysicist to postulate certain possible physical causes of the observed effects. The geological causes underlying these effects are not always understood by the geophysicist.

Data obtained by different geophysical methods should be worked out independently and without the aid of geological information, and plotted on separate maps. The maps prepared by the geophysicist should be submitted to a competent geologist who has a thorough understanding of the physical background, and who will combine geological and geophysical data on a new map. If the result differs radically from the geophysical map, the geophysicist must examine it to find out if any of the differences are incompatible with the data.

The geophysical method must be chosen to suit the problem.

It seems warranted that geophysics will, in the near future, be able to find oil directly, and will furnish dependable methods and apparatus for locating stratigraphical occurrences. The function of the geologist will be reconnaissance to indicate to the geophysicist where prospecting will most likely give quick results. The geophysicist can "see" below the surface, not the geological markers which the geologist wishes to observe, but significant variations in physical properties. G. D. H.

600. New Method of Seismic Survey Affords more Information. L. C. Uren. *Oil & Gas J.*, 11.3.37, **35** (43), 52.—The Rieber Sonograph uses a "receptor" in which a piezo-electric quartz crystal transforms a selected part of the earth vibrations into electrical impulses. These impulses then pass through a specially controlled amplifier, and are finally recorded on a strip of motion picture film. The record on the film is not the familiar wavy lines, but a selected portion of the impulses preserved as variable density wave-trains comparable to "sound tracks" on motion picture sound film.

Ten receptors are placed in shallow holes arranged in a special pattern with respect to the shot holes, and connected by cables to the amplifiers and recording equipment on a truck. The ten records are made on a single film, together with a track of a tuning-fork record to give time intervals, and the instant of the explosion. The developed film is passed through an analyser which can be set to transcribe only waves which reach the surface from a given direction. The operation is repeated for other directions, and as many as forty settings may be required for a complete analysis. From the curves so obtained the individual reflected waves may be identified.

In the research involved in the development of the apparatus, work on models revealed that faults may be the source of diffracted waves, which have not hitherto been recognized generally in reflection shooting.

The method is claimed to be of value under conditions which gave confused wave patterns with ordinary equipment. G. D. H.

601. Reflection Seismic Instruments and their Efficiency. C. A. Heiland. *Petr. Eng.*, March 1937, **8** (6), 91.—The conversion of the impulses arriving at the detector is generally achieved in two steps: (*a*) transformation of mechanical into electrical energy; (*b*) re-transformation of electrical energy into mechanical impulses with a beam of light as a magnifying lever. The first operation is accomplished by electrical vibration detectors—"capacitative" type using the principle of the condenser microphone; the "electromagnetic" type, which is subdivided into "inductive" and "reluctance" forms, and the piezo-electric microphone using quartz or Rochelle salts. The second operation involves the use of various types of galvanometers—damped vibration galvanometer of moving coil type; loop or "Duddell" type of oscillograph, and string galvanometers of the "Einthoven" type. Between these two units an amplifier is inserted to increase the signal strength. Amplifiers vary widely in construction.

Generally six and sometimes twelve pick-ups are used, and in the "series" arrangement great numbers are employed to eliminate refraction and ground-roll interference.

It is not immaterial how the overall magnification is obtained. For the best reproduction and minimum of interference, the energy level at the source must be as high as possible, calling for maximum efficiency in the pick-up, and, owing to practical limitations in this direction, a highly sensitive galvanometer.

Inductive and reluctance type detectors can be made into more efficient units than the capacitative and piezo-electric forms. As regards recording galvanometers, it seems that the most suitable types are oscillographs and coil galvanometers.

G. D. H.

602. Gravity in South-eastern Virginia. C. H. Swick. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 333–339.—In 1936 the U.S. Coast and Geodetic survey made gravity determinations at sixteen stations in Virginia, almost in a straight line from a point south-west of Richmond to one a few miles south-east of Norfolk. The stations were chosen to follow closely a line of seismic observations made by Ewing. Two sets of Brown gravity apparatus were used simultaneously, the stations averaging eight miles apart. The results are probably accurate within one or two milligals.

The data obtained are tabulated. The gravity gradient slopes towards the coast in agreement with the dip of the basement rocks, but is too steep to be explained as due only to a deficiency of density in the sedimentary rocks. A break occurs in the curve, on the sides of which the two parts of the profile of the anomalies are nearly parallel. The surface geology gives no indication of such a break, and a buried structural feature, such as a fault, is suggested. G. D. H.

Drilling.

603. Portable Rigs for Shallow Drilling. D. M. Auld. *Oil Weekly*, 1.3.37, **84** (12), 28.—The author discusses various types of portable drilling rigs with special attention directed to the feature of portability and size for certain duties up to 2000 ft. Core drilling equipment is also considered in connection with secondary recovery development work. A discussion is given of a drilling unit devised to drill shallow wells with rotary tools. L. V. W. C.

604. Sinking Oil Shaft in Haenigsen-Niewhagen. W. Sack. *Oil Weekly*, 15.3.37, **85** (1), 31.—The experiences gained in the development of the first oil shaft in the Wietze–Steinfoerde field of Germany has assisted the Gewerkshaft Elverath to undertake underground development of oil structures in the Hanover field.

The ordinary freezing method for areas where water levels are extremely high and the seepages strong is both costly and slow and the oil shaft in the Hanover field was therefore cased, although it was 24 ft. in diameter.

The 24-ft. casing was of concrete and the drive shoe was reinforced. This shoe was 2½ ft. high with a wall strength of 14 in.

The drive shoe was placed and the first ring then locked into it and the space between the walls filled with concrete. The remainder of the rings were then placed and the water level was maintained by the application of a large centrifugal pump and this kept the level within the shaft about 10 ft. below normal. L. V. W. C.

605. Long Usage Proves Success of Centralized Mud Plants. T. P. Sanders. *Oil & Gas J.*, 4.3.37, **35** (42), 32.—The provision of a centralized mud plant in the Dominguez field has resulted in the elimination of serious trouble from stuck drill-pipe during the six years the plant has been in operation.

Better and cheaper fluid is possible from a good central mud plant, adequate supplies of mud, water and oil for immediate use at the drilling well are made available, and the cost of digging and filling in mud pits at each location is saved.

Before return to the well, the mud from the wells must be treated to remove gas, oil and cement.

The economies realized through the use of a centralized mud plant have resulted in many operators adopting this practice. L. V. W. C.

606. Coring and its Applications in Modern Petroleum Prospecting. J. Klep. *Petr. Eng.*, Feb. 1937, **8** (5), 162.—A comprehensive description is given of the various coring devices and the methods of the operation. L. V. W. C.

607. Directional Drilling and its Applications to Petroleum Prospecting. Anon. *Petr. Eng.*, Feb. 1937, **8** (5), 149.—A résumé is given of the various methods being employed in controlled directional drilling considering the three essentials to be: deflection tools, means to orient the deflection tool in the required direction and means to survey accurately the path of the hole. L. V. W. C.

608. Easy Erection and Dismantling Plus High Salvage Value Feature Uniform Boiler Setting. J. C. Albright. *Oil Weekly*, 22.3.37, **85** (2), 20.—A uniform setting which is economical has been designed for temporary installations of movable field boilers used as power for rotary well drilling in concentrated areas. In this installation the boilers are erected and mounted in such a manner that the entire battery may be easily and quickly dismantled and moved to another location with the least possible loss of time. Each boiler is considered as a unit, and the battery may be expanded or reduced in size as drilling conditions warrant. Skids, permanently attached to each unit, serve as the boiler foundation, which in turn is mounted on a substructure carrying the full weight of the unit. This allows the combustion chamber to serve the purpose of the furnace only, carrying no weight other than its own firebrick walls and accessories. The substructure is designed in sections consisting of two bends and made of old drill-pipe. L. V. W. C.

609. Hard Alloys. I. Ganitzki, *Mon. Petr. Roum.*, 1937, **38**, 325–327.—A brief historical survey of stellite and the tungsten carbide and boron hard alloys, and their application to the petroleum industry. Mention is made of uses such as valve-seatings of combustion engines, but the article deals particularly with the hard-facing of drilling tools.

Approximate composition and variations of composition are shown and the methods of preparing the alloys and welding them to the tools are briefly discussed. Branded names mentioned or discussed are Widia, Haystellite, Borium, Relit, Pobedit, Blackor, Britor and Griffiner. Composite rod is a modern and improved form for hard-facing with tungsten carbides. T. C. G. T.

610. Drilling Patents. C. E. Thomas. U.S.P. 2,072,320, 2.3.37. A bit guide, in combination with a drill stem, surrounding the stem and having teeth which engage the walls of the well and passages to allow the circulating fluid to pass. A clutch is provided to enable the guide to remain disengaged from the stem.

C. E. Kelso. U.S.P. 2,072,338, 2.3.37. An oil-well grapple operated by fluid pressure.

O. J. McCullough. U.S.P. 2,072,341, 2.3.37. An outside casing cutter.

J. W. Taylor. U.S.P. 2,072,435, 2.3.37. A flow valve for well tubing.

J. Grant. U.S.P. 2,072,859, 9.3.37. A well reaming tool having a plunger-operated cutter, plunger operated by the circulating fluid.

F. W. Huber. U.S.P. 2,072,950, 9.3.37. A method of determining the nature of the natural fluid contained in a porous formation by measuring and comparing variations with electrical resistivity of the formation parallel and close to the bore-hole where the formation is permeated with the conductive fluid.

C. R. Dale. U.S.P. 2,072,982, 9.3.37. A method of cementing wells whereby the cement is driven through the perforations of the casing into the space between the casing and the wells by subjecting the cement to high-frequency vibrations.

J. E. Brantly. U.S.P. 2,073,093, 9.3.37. Well pipe and tool-joint.

M. Johnston. U.S.P. 2,073,107, 9.3.37. A well-testing device consisting of a tubing string and packer. Packer is equipped with valves, one of which is opened by movement of the tubing, and the other independently of the tubing.

C. H. Sweet. U.S.P. 2,073,126, 9.3.37. Well-cleaning system.

H. M. Hohmann and H. de Wilde. U.S.P. 2,073,263, 9.3.37. A core drill comprising a core barrel provided at its upper end with an upwardly opening valve, which will allow the core to pass out of the core barrel in an upward direction, and valve means to allow the passage of the circulating fluid only from the interior of the drill outwardly to the space around the drill.

D. P. May. U.S.P. 2,073,311, 9.3.37. A device for removing liquid from gas lines.

C. C. Brown, S. N. Van Wert and A. Aruntunoff. U.S.P. 2,073,623, 16.2.37. A transmission mechanism for transforming the rotary movement of an electric motor shaft into the reciprocating movement for operating a pump.

G. C. Oliver. U.S.P. 2,073,876 and 2,073,877, 16.3.37. Core barrel.

D. H. Reed. U.S.P. 2,074,430, 23.3.37. Pump and valve assembly.

D. E. Humphrey. U.S.P. 2,074,548, 23.3.37. Derrick construction.

D. E. Humphrey. U.S.P. 2,074,549, 23.3.37. Hanger for walking beams.

D. E. Humphrey. U.S.P. 2,074,550, 23.3.37. Pumping jack.

J. E. Gosline. U.S.P. 2,074,608, 23.3.37. An apparatus for producing wells consisting of a tubing string extending from the top of the casing to a point adjacent to

one of the perforated zones, and a packer above this zone to separate fluid from above and below, and means provided at the surface to control the admission of fluid from the upper zone into the tubing string.

B. Granville. U.S.P. 2,074,692, 23.3.37. Deviation finder.

G. B. Kitchel. U.S.P. 2,074,923, 23.3.37. Casinghead.

L. V. W. C.

Production.

611. Central Power is Economic Construction on Small Lease Producing from Shallow Pay. Anon. *Oil Weekly*, 15.3.37, **85** (1), 50.—A central power combining the advantages of a number of units has recently been placed in operation in Oklahoma. Two wells are being pumped at approximately 1000 ft. in the newly opened Airport pool. The prime mover is an 8-cylinder "V"-type automobile engine adapted to use natural gas. A simple clutch takes the place of the motor transmission. A winch acts as a power reducer between the engine and the pumping power and the jackshaft rotates freely during routine pumping and carries a large and small pulley transmitting power from the engine. In addition, the winch can act as a pulling machine for the wells being pumped. L. V. W. C.

612. Handling of Record Pressures are Solved at Old Ocean by Unique Flow Arrangements. B. Mills. *Oil Weekly*, 29.3.37, **85** (3), 20.—The deep well recently completed in the Gulf Coast has created a pressure problem that has been solved by unique flow arrangements. The surface pressure on the tubing is 3900 lb., and the flow of gas and very light oil requires careful choking and regulating. All flowhead connections are tested to 6000 lb. before installation, and the arrangement of the flowhead is the most elaborate yet used in any field. Double choking reduces the pressure on flow lines and gives a safety factor not found where a single choke is used.

Heaters are installed to prevent freezing before separation and loss in line pressure.

The production from the well is nearly a distillate having a gravity ranging from 50 to 67. L. V. W. C.

613. Offset Water Well. F. B. Taylor. *Oil Weekly*, 22.3.37, **85** (2), 26.—A water well has been drilled to a fresh water bearing sand at 107 ft. in the Hilger pool, Kansas, to supply lease water for general use. This well has been drilled only a few paces from an oil producer, and the water is pumped directly into a 1600-brl. storage tank about ¼ mile from the location, and is being lifted to the surface by the ordinary lowered pumping barrel arrangement. The weight of the pumping rods is not sufficient to hold the cable, which replaces the customary rod hookup, taut during the down stroke, and a weight of about 140 lb. is applied to eliminate this condition. L. V. W. C.

614. Present Trends and Practices in Well Completions. A. W. Walker. *Oil & Gas J.*, 4.3.37, **35** (42), 35.—Among the more important improvements in well-completion practices may be mentioned the following. The many advantages of pressure drilling with oil as the drilling fluid have been discussed but one point made by the author has not been mentioned previously. It has been observed that within any single pay zone the productivity reaches a maximum very near the top of the zone and then declines, and this can be interpreted as representing a condition of optimum potential due to the energy initially released in the associated gas, rather than as a reflection of the reserves. If it is desired to obtain maximum potential with natural flow full penetration should not be taken, but full penetration will be necessary if it is desired to obtain the highest potential with artificial flow and the greatest ultimate recovery.

The important advantages claimed for reverse circulation are ready portability for drilling-in and deepening wells, low surface working pressures and power requirements, rapid delivery of cleaner and better cutting samples at the surface and low bottom-hole working pressures.

Acidizing wells is now common practice for new wells and the practice of casing

completely through the productive zones and then selectively gun-perforating the desired zone has been well received.

Better drilling fluids have assisted in improving operating conditions. Core barrels have been improved and drill stem tests have very nearly become routine practice in certain areas.

Electrical surveying is general practice and devices for recording and logging the temperature changes with depth have recently been introduced. L. V. W. C.

Gas.

615. Gas Purification with Sodium Phenolate. Anon. *Refiner*, 1937, **16** (2), 90–91.—The S.O.C. California have operated since August 1936 the Koppers sodium phenolate process to remove 4·5% hydrogen sulphide from cracked gas, the throughput being 13,000,000 cu. ft./day. The hydrogen sulphide is oxidized to sulphuric acid, the average daily yield being 85 tons. The Atlantic Refining Co. are now erecting a similar unit to desulphurize 22,000,000 cu. ft./day of gas at 225 lb. pressure. The desulphurized gas in both cases is intended for polymerization. The phenolate solution is made from caustic soda and crude phenols, and is then circulated continuously through the absorption and the actification stages of the plant. In the absorption stage this solution will take up 2000 to 4000 grains H_2S per gal., so it is only necessary to circulate 5–10 gals. per 1000 cu. ft. gas. The solution, after leaving the absorber tower, passes through heat exchangers to the actifier tower, where the H_2S and solution are separated by steam. The stripped solution is cooled and used again. A flow sheet is given. G. R. N.

616. Determination of Unsaturates in Gas. A. I. Yuzhilin and V. B. Dobrotvorskaya. *Khim. Tver. Topliva*, 1935, **6**, 953.—As a result of the study of various methods for the determination of C_2H_4, etc., a new method was worked out which permits a separate determination of members of the hydrocarbon series C_nH_{2n} and C_nH_{2n-2}. This method is as follows: first, C_2H_2 is determined by absorption with HgI_2, then C_6H_6 with 64% H_2SO_4, next C_3H_6 with 84% H_2SO_4, and finally C_2H_4 with 103·5% H_2SO_4. Twelve references. For. Petr. Techn.

617. Gas Purification with Phenolate Solution. I. Nikhanov. *Novo. Tekhn.*, 1936, **26**, 19.—A sodium phenolate solution, obtained by washing shale, coal or peat tar with 10–12% NaOH, was used for purification of gas containing a large amount of sulphur. The reactions were:

$$C_6H_5ONa + H_2S = NaHS + C_6H_5OH$$

and $C_6H_5ONa + CO_2$ and $H_2O = NaHCO_3$ and C_6H_5OH, taking place at 25–30° C., phenolate and salt layers being formed. The reverse action occurs at 108–110° C., and is used for regeneration of the phenolate solution. The absorption velocity for H_2S is considerably greater than that for CO_2, being absorbed more completely. A litre of sodium phenolate will absorb 30 litres of H_2S and 5–8 litres CO_2.
For. Petr. Techn.

618. Patents on Gas. J. Y. Johnson. E.P. 461,001, 2.2.37. Removal of organically bound sulphur from gases by bringing the gas together with moisture into contact with an organic amine.

I.G. Farbenindustrie A.-G. E.P. 461,636, 22.2.37. Apparatus and method of washing of gases.

Flaschengas-Geräte Ges. E.P. 462,171, 1.3.37. Receptacle for liquefied gas, *e.g.* propane.

G. W. Johnson. E.P. 462,311, 5.3.37. Apparatus for measuring the density of gases.

A. E. Buell and W. A. Schulze. U.S.P. 2,075,112, 30.3.37. Desulphurizing hydrocarbon gas by heating it to 500–800° F. and contacting it with a catalyst containing a tungsten compound.

A. E. Buell and W. A. Schulze. U.S.P. 2,075,173, 30.3.37. Desulphurizing hydrocarbon gas as described above using a molybdenum compound as catalyst.

A. E. Buell and W. A. Schulze. U.S.P. 2,075,174, 30.3.37. Desulphurizing hydrocarbon as described above using a cadmium compound as catalyst.

A. E. Buell and W. A. Schulze. U.S.P. 2,075,171, 30.3.37. Process as described in U.S.P. 2,075,173 using a vanadium catalyst. W. S. E. C.

Crude Petroleum.

619. Crude Oil from Sherman, Michigan. Anon. *Petr. Eng.*, Feb. 1937, **8** (5), 191.—The crude from the discovery well in this area has been analysed by the Bureau of Mines and found to be a paraffin base oil. The gasoline and kerosine fractions appear to be more paraffinic than corresponding fractions from most other Michigan crudes. Principal characteristics are: Sp. gr. 0·788, sulphur 0·40%, Visc. S.U. at 77° F.–36 secs., pour point below 5° F., colour N.P.A. No. 5, carbon residue 0·3%. Approx. yields obtainable by Hempel distillation are: Total gasoline and naphtha 40% of sp. gr. 0·719, kerosine distillate 20% of sp. gr. 0·792, gas oil 10·1% of sp. gr. 0·830, lubricating distillates 13·1%, residuum 14·3% of sp. gr. 0·902. The sample was obtained in Nov. 1936 at a depth of about 3600 ft. R. A. E.

620. Analyses of Canadian, Polish and Peruvian Crude Oils. G. Egloff. *Oil & Gas J.*, 4.2.37, **35** (38), 41.—The properties and yields by Hempel distillation of the crudes from the following fields are recorded: *Canada* (Calgary, Alberta; Petrolia, Ontario; Bothwell, Ontario; Mosa, Ontario; Fort Norman, Mackenzie River; and Strong Creek, New Brunswick). *Peru* (Lobitos and El Condor), *Poland* (21 crudes of the four main types: (*a*) paraffinic, (*b*) naphthenic, (*c*) mixed paraffinic-naphthenic and (*d*) containing large amounts of aromatics, unsaturated or terpenes).

Brief notes on the refineries operating in the countries mentioned are included. C. L. G.

621. Properties of Czechoslovakian, Austrian and Egyptian Oils. G. Egloff. *Oil & Gas J.*, 18.2.37, **35** (40), 55.—In Czechoslovakia naphthenic crudes are obtained from the Miocene stratum in the Egbell and Hodonin areas, and paraffinic crudes in small quantities from the Bohuslavice, Turzovka and Mikovd regions. There are 11 refineries having a total daily capacity of 10,225 brl. and one cracking plant of 1100 brl. capacity in the country. Austria produces a small volume of crude of mixed paraffin and asphalt base from three fields. The total daily refinery capacity is 8150 brl. with no cracking installation. Crudes from the three Egyptian fields differ widely in character, and productive depths range from 1290 to 2000 ft. There are two refineries with a total daily capacity of 11,500 brl. and a cracking capacity of 2000 brl. Analyses and yields and properties of the products obtainable from the various crudes are tabulated. R. A. E.

622. Blending Gulf Coast Crude with Natural Gasoline for Foreign Shipment. Anon. *Petr. Eng.*, Feb. 1937, **8** (5), 49.—Crude from fields in the vicinity of Corpus Christi, Texas, is too heavy in gravity to meet demands of French buyers for export. It is therefore blended with 6% of natural gasoline, which is received at the blending plant in tank cars and is transferred to pressure storage tanks of 24,000 gal. capacity. A vapour line extends from the pressure tank to the car during the unloading operation, thus maintaining constant pressure on tank and car. Crude oil and natural gasoline are blended in tanks of 20,000 to 93,000 brl. capacity, the bottoms of which are provided with spreaders, so that as the natural gasoline is pumped into the bottom of the tanks, it spreads upwards through the crude oil, blending with it. The pumping unit and special safety-valve to prevent overloading are described. All blending lines to crude tanks are 6-inch. Evaporation loss is minimized by blending cargoes immediately before loading, the time of blending being controlled by tanker capacity and the possible speed of blending, which is 800 brl. per hr. R. A. E.

623. Patents on Crude Oil. M. de Groote and B. Keiser. U.S.P. 2,072,085, 2.3.37. Breaking petroleum emulsions using esters of sulphosuccinic acid.

P. R. Hershman. U.S.P. 2,074,183, 16.3.37. Desalting crude oils using a solution of sodium acetate and then treating the desalted crude with bicarbonate of soda at 130° F. under pressure. W. S. E. C.

Cracking.

624. Cracking Methane in a High Tension Arc. N. P. Bozhko and D. L. Orshanskii. *Khim. Iver. Topliva*, 1936, **7**, 59–71.—The products obtained on cracking methane in a high tension electric arc are C_2H_2, C_2H_4 (traces), carbon and hydrogen. The total cracking increases with the increase of the CH_4 content in the initial gas up to 15–20%, decreasing thereafter. A maximum total cracking for a given layout with a gas velocity = 9·3 litres/hr. and 0·4 kW. is equal to 86·9% and the useful cracking 84·7%. A variation of the velocity of the gas flow from 10 to 130 litres/hr. does not change the character of the cracking. A low-tension arc (0·150 kW.) promotes almost exclusively useful cracking, whereas the high-tension arc promotes carbon and hydrogen formation and the useful cracking increases only to a certain level, then decreases. The energy consumption may be lowered by an increase of the CH_4 content in the initial gas, or, more effectively, by an increase of the velocity of gas flow. The energy consumption at a gas velocity of 132 litres/hr. for a gas containing 54% CH_4 and at 0·4 kW. is 21·6 kW./hr. Twenty references. For. Petr. Techn.

625. Patents on Cracking. A. Cambron and C. H. Bayley. E.P. 461,392, 16.2.37. Vapour-phase cracking of heavy hydrocarbons to produce hydrocarbons of high aromatic content by passing the vapour in turbulent flow through a tube heated externally to 600–700° C. W. S. E. C.

626. Patents on Pyrolysis. W. W. Gary. U.S.P. 2,072,801, 2.3.37. Pyrolysis of hydrocarbon gases by passing them through tubes made of a chromium alloy in a heating furnace. Air is first passed through the tubes at high temperatures to remove carbon and then an acid pickling solution is added to remove oxide film—the acid solution is removed.

A. Fischer. U.S.P. 2,073,367, 9.3.37. Conversion of coal into liquid products by heating under substantially non-coking conditions—and then coking the residue and subjecting the vapour products from the coke zone to fractionation. W. S. E. C.

Hydrogenation.

627. Patents on Hydrogenation. Usines de Melle. E.P. 462,349, 8.3.37. Catalytic dehydrogenation of saturated hydrocarbons using a chromium catalyst.

A. M. Muchenfuss. U.S.P. 2,073,973, 16.3.37. Hydrogenation of hydrocarbon oil containing unsaturated compounds in the presence of an alkali metal hydrocarbide at 250° C. and under pressure.

H. Dreyfus. U.S.P. 2,075,101, 30.3.37. Hydrogenation of coal impregnated with an aqueous medium consisting of salts of oxyacids of phosphorus—at 300–500° C. and at atm. pressure.

M. H. Gwyan. U.S.P. 2,073,578, 9.3.37. Hydrofining of petroleum distillates using a reduced nickel catalyst in the liquid phase. W. S. E. C.

Polymerization.

628. Mechanism of Vinyl Polymerization. P. J. Flory. *J.A.C.S.*, 1937, **59**, 241–253.—In this paper the term "vinyl polymerization" is used to include not only polymerizations of derivatives of vinyl alcohol, but all polymerizations involving

olefinic double bonds, and leading to products of high molecular weight. The known characteristics of such polymerizations have been accounted for by a mechanism consisting of four processes: (1) chain initiation, (2) chain propagation, (3) chain transfer, (4) destruction of active centres. The free radical active centres must of necessity be both created and destroyed in pairs. The previously proposed process of coupling of monomers to the free radical through the opening of the double bond has been adopted for chain propagation.

A chain transfer process whereby the active centre is transferred from one polymer molecule to another molecule, leaving the former "inactive" and endowing the latter with the ability to add on monomers successively, has been introduced in order to account for the independence of molecular weight on number of active centres.

Upon the basis of this mechanism the kinetics of the conversion have been subjected to a theoretical analysis, and equations have been derived to represent the course of the conversion. These are in satisfactory agreement with the limited available experimental data.

Activation energies of the individual processes have been estimated from experimental data, i.e. for Styrene $E_1 = 32$ k.-cal.; $E_2 = 6$ k.-cal.; $E_3 = 12$ k.-cal.

Heats of polymerization have been calculated for a number of unsaturated compounds and for all types of mono-olefins the heat of polymerization equals -23 ($\pm$ 1) k.-cal.

The paper contains probable mechanisms for the individual reactions involved in various polymerizations. W. E. J. B.

Refining and Refinery Plant.

629. "Stratcold" Treating Process. J. A. Altshuler, F. G. Graves and E. S. Brown. *Nat. Petr. News*, 24.3.37, **29** (12), 71.—The article deals comprehensively with a commercial unit using the centrifugal acid contacting process at low temperature for the refining of cracked gasoline. The distillate is treated with acid in cooled, high-dispersion centrifugal contactors and separated in centrifuges operating at 7500 r.p.m. The distillate is contacted three times, at the same or different temperatures, twice with used acid and finally with fresh acid. The effect of temperature on treating losses is considerable. At 60° F., 60° F., 60° F. (the temperatures of the three separate treats) and with 98% H_2SO_4 used at the rate of 10 lb. per barrel of distillate the loss was 7·3% vol., at 40° F., 40° F., 30° F., 6·2% vol., and at 30° F., 30° F., 20° F., 5·5% vol. Similarly loss due to polymerization was 5·5% vol. at 60° F., 60° F., 60° F., 3·8% vol. at 40° F., 40° F., 30° F., and 2·7% vol. at 30° F., 30° F., 20° F. Octane rating was reduced 1·3 units at 60° F., 60° F., 60° F., and 0·7 units at 30° F., 30° F., 20° F. Since the heat of reaction varies as the acid rate, power consumption for cooling increases with increase in the acid rate. With 5·5 lb. 98% H_2SO_4 per barrel power for cooling was 0·7 kWh. per barrel and 1·3 kWh. per barrel for 16 lb. acid per barrel. Owing to the efficient separation of the acid sludge, marked economy in caustic soda is achieved. H. G.

630. Naphtha and Lead-Recovery System Proves Economical. C. W. Berger. *Oil & Gas J.*, 11.3.37, **35** (43), 81.—The plumbite recovery unit successfully used at a Kansas refinery consists of a centrifugal demulsifier (operating at 12,500 r.p.m. and handling 5–7 brl. per hour) and a regenerator (designed to handle 12 brl. of solution per hour containing 8–10 lb. soluble lead per brl.), together with storage and pumping facilities. The regenerator consists of a shallow flat-bottomed tank containing a slotted rotor electrically driven at 490 r.p.m. inside a slotted cylindrical stator. Radiating ducts are fitted into a perforated false bottom in the tank, so that the liquid is forced out of the stator slots in the form of a fine mist into which the air comes into intimate contact, effecting thorough regeneration. After demulsification no heat is required in the system, high temperatures not giving increased efficiency. The doctor solution recovered is superior to that given by the conventional steaming-and-blowing system, the strength and gravity being uniform and the solution free from emulsion or naphtha. Estimated savings on chemicals and gasoline recovered are given as $25.000 per annum. C. L. G.

631. Petroleum Emulsions. M. J. Leahy. *Refiner*, 1937, **16** (2), 88–89.—The subject is divided into oilfield emulsions, breaking emulsions, use of soap and other petroleum emulsions. Since sodium and ammonium soaps are hydrophilic, they are used for breaking oilfield emulsions. Sulpho soaps are produced by sulphuric-acid treatment of the vegetable oil before saponification. The product varies according to the conditions of preparation. The presence of free glycerol is generally advantageous. There are many useful petroleum emulsions, which are noted as follows. Asphalt emulsions are employed in road-building or in paint. Various types of steam-engine lubricants, greases and insecticidal sprays are emulsions. Printing ink can be made by emulsifying carbon black with glycerol and lubricating oil. Emulsions of sodium soap and oil and water and road oil are used as water-softening and dust-laying materials respectively. Zinc chloride can be emulsified with fuel oil to give a wood preservative, whilst sewage can be clarified by emulsification with petroleum oil.
G. R. N.

632. Selection of Tube Stills. A. N. Leibo. *Azerb. Neft. Khoz.*, 1936, **1**, 72.—Radiant sections should be built with one bank of tubes only, because in the case of two or more banks they are shielded by the lower bank, thereby decreasing the heat transfer by about 30%. The construction of the coils should be such as to permit the use of 95° return bends, thereby decreasing the cost of construction and improving performance. Preference is given to multi-flow furnaces, which allow the use of smaller tubes and reduce hazards characteristic for tube joints with large return bends. Arrangement of convection tubes on the furnace sides reduces expense and facilitates cleaning. A description of the Leibo tube still is given. For. Petr. Techn.

633. Heat Transfer in Paraffin Crystallizers. I. G. Golomshtok. *Grozn. Neft.*, 1936, **6** (5), 51.—The investigation was carried out to calculate the heat transfer in brine coolers used in the paraffin works. It was found that the total heat transfer coefficient is always lower than the lowest partial heat transfer coefficient, and that an increase in the velocity of the brine flow cannot increase the total heat transfer coefficient. An increase of this velocity will lower the difference between the inlet and outlet temperatures, thereby increasing the mean difference in the temperatures. Under refinery conditions the difference between the inlet and outlet brine is only 3° C., and the calculation shows that a lowering of this difference to 2° C. raises the mean temperature difference only by 0·43° C., which is of no practical importance. Therefore an increase in the velocity of the brine does not produce a heat effect, but increases only the pumping expenses. The heat-transfer coefficient of the crystallizer cannot be improved practically by direct ammonia evaporation. According to the equation $1/K = 1/d_1 + \Sigma\frac{\delta}{\lambda}$, the total heat-transfer coefficient through the walls is always lower than the lowest partial coefficient. Accordingly, the value of the partial coefficient d_1 from the distillate to the wall cannot be determined. The maximum value of K, based on American data, is 150 Cal./sq. m./° C./hr. The partial coefficient d_2 from the wall to the brine in the evaporators may vary from 700 to 4000 Cal./sq. m./° C./hr. Therefore d_1 is always lower than d_2 and the value of K is lower than d_1. Calculations show that a change of d_2 from 400 to 4000 Cal./sq. m./° C./hr. is accompanied by an increase of K by only one calorie. The total heat-transfer coefficient may be increased by regulating the velocity of the distillate feed, but this may affect adversely the crystallization conditions. An increase in throughput can be effected by lowering the initial temperature of the brine. For. Petr. Techn.

634. Desulphurization of Oils. C. M. Cawley. *J.I.P.T.*, 1937, **23**, 209–212.—The Malishev method of removing thiophene from benzene by use of carbon monoxide at 300° C. in the presence of molybdenum trisulphide is confirmed. It is shown that under similar conditions carbon monoxide is not effective for the desulphurization of benzole, low-temperature tar oil or lubricating oil. G. R. N.

635. Desulphurizing Irak Petroleum with Finely-Divided Copper. C. Baron. *Ann. des Comb. Liq.*, 1937, **12**, 25–28.—The article suggests a method of removing sulphur

from petroleum, on a commercial scale, by agitation with very finely divided copper, the copper being recovered by driving off the sulphur as SO_2 in a roasting furnace.

The author outlines a procedure for which costs are estimated, and then proceeds to suggest outlets for the sulphur as sulphuric acid, pyrites and copper sulphate. Eventually the author calculates that the process could be worked to produce a profit. Experiments further show that distillation of petrols over finely divided copper yields a gum-free product. T. C. G. T.

636. Desulphurization of Benzene with Aluminium Chloride. N. Kozlov and Z. Dubeishstein. *J. Applied Chem. (U.S.S.R.)*, 1936, **9**, 1994.—About 70% of the sulphur was removed from a mixture of benzene and mercaptan (sulphur 0·5917%) and benzene and thiophene (sulphur 0·5643%) by passing their vapours through crystalline anhydrous aluminium chloride in a continuous apparatus (scheme is given) for one hour. The formed gases were absorbed by $CdCl_2$ with formation of CdS.

For. Petr. Techn.

637. Desulphurizing of Spirits by Absorption. M. Dabrisay. *Ann. des Comb. Liq.*, 1937, **12**, 29–35.—Experiments to extract sulphur and sulphur compounds from petroleum spirit using alumina which has been brought to maximum activity by heating at 800° C., show that sulphur compounds may be catalytically oxidized to free sulphur by the earth. Thus, a white spirit containing sulphur compounds was deodorized, but remained highly corrosive to copper. The author claims a method of desulphurizing by a mixture of activated earth containing copper compounds which absorb free sulphur produced by the catalytic oxidation. Numerous earths are discussed, but kaolin and kieselguhr appear to be most suitable. The earth is impregnated with a copper nitrate solution and then heated to expel the oxygen, etc. Details of the procedure and of results obtained are given. The "coppered" earth may be regenerated after use by heat treatment. The author outlines his further programme of research, when he hopes to make this a commercial proposition suitable for heavy oil as well as light petroleum products. T. C. G. T.

638. Paraffin Odour and its Elimination. N. F. Bogdanov. *Grozn. Neft.*, 1936, **6** (1), 79.—Treated paraffin must be agitated with clay, the latter being replaced as soon as the paraffin odour could be noticed. The storage temperature must not exceed 75° C. The duration of storage of chemically treated but unbleached paraffin must be cut down to a minimum. The filters must be charged very gradually to permit a thorough contact of paraffin and clay and a complete displacement of air. Local overheating during the clay treatment must be avoided.

For. Petr. Techn.

639. Selection of Metal for Cracking Still Tubes. L. A. Aleksandrov and V. P. Sukhanov. *Grozn. Neft.*, 1936, **5** (5), 29.—Among the different carbon and alloy steels tested in the various parts of the cracking equipment it was found that: (1) losses (through corrosion) in carbon steel used in the radiant section exceed those of metal installed in the lower section of the bubble tower by ten times, and (2) losses of samples placed in the lower section of the bubble tower in mgms./sq. mm./30 days were for C-steel 0·129, Cr-steel 0·031, Cr–Mo-steel 0·028; for samples placed in the return bends of the cracking coil, for C-steel 1·258, Cr-steel 0·020, Cr–Mo-steel 0·011 and Cr–Ni-steel 0·00011. Sixteen references. For. Petr. Techn.

640. Corrosion of Metals in the Foster Wheeler Bubble Tower. P. S. Lisitsyn and A. B. Kocharyan. *Grozn. Neft.*, 1936, **6** (1), 72.—Plates covered with Cr, Cr–Va, Al and cast iron were placed in various sections of Foster Wheeler atmospheric and vacuum towers and left there during 13 months. The effects of corrosion are tabulated, and it is stated that the additional expense through the use of alloyed steels, etc., is not justified if the crude oil receives a preliminary caustic treatment.

For. Petr. Techn.

641. Progress in Metals. W. L. Nelson. *Oil & Gas J.*, 18.3.37, **35** (44), 58.—*Furnace Castings.* The primary considerations in the selection of a furnace casting are:

(1) Resistance to scaling, (2) strength at elevated temperatures and (3) cost. Scaling may be due to (*a*) plain oxidation, (*b*) sulphidization, or (*c*) carburization. (*a*) Plain oxidation occurs in furnaces fired with low sulphur fuels with ample excess air. A list of suitable Cr, Cr–Ni and Ni–Cr alloys to resist oxidation is given. (*b*) To resist sulphidization from fuels containing more than 1% S, Cr–Ni steels are generally regarded as superior to plain steels. (*c*) To resist carburization which is less common and occurs when insufficient air is used, the Ni–Cr steels are most suitable.

Strength at elevated temperatures is given by keeping the percentage of carbon low and introducing small amounts of Mo, Si, Wo, Ti, Se, Cb, etc. Data are given on the safe working stress of a number of alloys, but it is emphasized that the real test of these special elements depends on the cost as compared with that of the simpler alloys.

Impact Resistance of Nickel Steels at Low Temperatures. The exceedingly low temperatures encountered in solvent dewaxing processes frequently causes failure of steels of normal strength at ordinary temperatures. Nickel steels appear to be among the best relatively cheap materials for such conditions. Data on the Charpy impact test of various nickel steels at temperatures of 70° F. to − 35° F. are given.

Metallurgical Terms—Creep Strength or Creep Limits. Tensile strength tests at high temperatures do not allow for the stretch or creep which takes place slowly at high temperatures, resulting in the metal failing at strengths far below that given in the test. The creep strength is therefore determined by subjecting a tube to internal pressure for a long time at a high temperature. It is defined as the stress expressed in lb. per sq. in. that a material can withstand at a given temperature without exceeding a given rate of creep or stretch. C. L. G.

642. Removing Traces of Acid Sludge. D. A. Kalimanov. *Grozn. Neft.*, 1936, **6** (3), 49.—The following procedure has been adopted in the second cracking unit of the Grozny refinery. The unrefined cracked distillate is pumped from the tank into the first mixer with the acid. The mixture, after passing through a second mixer, enters a settling tank at its lower end, where the acid settles and is removed to the reconditioning plant. The distillate is passed through a flushing-tower, being washed with water. The washed distillate enters a caustic treatment vessel, water and caustic being continuously withdrawn. NaOH is continuously circulated, and the distillate is passed through another settler, then sent to storage. According to the modified method, the untreated P.D. is passed into a mixer with acid, the mixer being then passed through a 6-inch pipe, through a diaphragm mixer, and then a settler-coagulator, and the acidic product, which is almost completely freed from the acid, is passed through a second filter coagulator. It is next finished by NaOH treatment, followed by separation of this solution in two settlers. For. Petr. Techn.

643. De-Emulsifiers from Acid Sludge. V. Parkhomenko. *Nov. Neft.*, 1936, **3** (16), 5.—Acid sludge from the third to seventh to eighth treatment of white oils with oleum is water-washed, then neutralized with NaOH, small portions of water and soda being used. The de-emulsifier is then improved by adding a bright petroleum product, *e.g.* kerosine, gas oil, etc., at 50–90° C. The latter efficiently extracts the tar. This de-emulsifier is as efficient as naphthenic acid, and a saving of up to 10% of the treated oil is effected. For. Petr. Techn.

644. Bentonite Clays. V. S. Sharov. *Grozn. Neft.*, 1936, **6** (3), 10.—Dry bentonite clay when placed in 1·5% and 10% tannin solutions swells rapidly, disintegrating into lumps of several sizes. After 3 days analysis of the disintegrated lumps showed 960% water in water, 665% water in 1% tannin, 317% in 5% tannin and 164% in 10% tannin solution. The action of tannin is due to: (1) the appearance of a polar active group on the clay surface, which for tannin is represented by the glucose group C_6H_7O, and (2) the apolar inactive group represented by a long aromatic chain in tannin. The first group attracts the bi-polar water molecules, and is therefore the hydrophilic group. The second group is inert to water and is the hydrophobic group. In contacting the clay with an aqueous tannin solution, the hydrophilic ends of the molecule of the latter are attracted by the surface layer of the clay, whilst the longer—the hydrophobic ends of the molecules—orientate towards the outside.

Such an attraction is explained by the presence of free charges at the exposed anions and the absorbed cations of the clay particles. On the surface of the clay is formed a "brush" of hydrophobic ends of the tannin molecules. At a suitable concentration of the tannin, this "brush" creates a wall preventing the penetration of water into the clay, thereby inhibiting the hydration of the latter. The disintegration of the bentonite clay in solutions of salts is explained by the lowering in the hydration, which is accompanied by the increase in the velocity of hydration. The effect of hydration depends not only on the concentration of tannin, but also on the coarseness of the clay. The structure of the clay becomes of secondary importance for high tannin concentrations. Among the gel-forming substances, gelatin, glue, starch and sodium silicate are commonly known. They are absorbed by the crevices on the clay surface, thereby dehydrating the sol and converting it into the gel, thus preventing the admission of water. These substances prevent the hydration of dry Na clays and highly dispersed clays. For. Petr. Techn.

645. Moisture a Factor in Clay Stability. V. S. Sharov. *Grozn. Neft.*, 1936, **6** (1), 58.—The disintegration of the clay in water is retarded with the increase in the water content of the former. A certain "critical" moisture content, which is characteristic for every clay, causes a fundamental change in the behaviour of the latter, one type of clay discontinuing further absorption of water, remaining unchanged for months when left in water, whilst other clays absorb water very slowly. Na clays swell gradually above their "critical" point, whilst Ca clays are more stable.
For. Petr. Techn.

646. Bleaching Clays; Part I. R. Fusstieg. *Petr. Eng.*, Feb. 1937, **8** (5), 98.—In the petroleum industry bleaching clays are chiefly employed for improvement in the colour of oils, but may also be used for the removal of traces of acids, alkalis or soaps, reduction of gum content and, to a slight extent, of sulphur content, as catalyst in the manufacture of by-products and for the prevention of "sludge" deposits in insulating oils. A discussion follows regarding the origin and chemical compositions of siliceous earths and the natural weathering processes involved. The main factor affecting the efficiency of fillers earth is the montmorillonite content ($Si_4O_{11}Al_2.H_2O$). This is present in the form of a structure with microscopic channels, but the manner in which these channels are filled is also of great importance. Other influencing factors are the contents of water, lime and magnesia.

The mineral bleaching clays may thus be divided into three types: (1) Fuller's earths with the developed montmorillonite structure, their microscopic channels being partly filled with other silicates. Action of diluted or weak acids leaches the rest of these inhibitors. (2) Inactive bleaching clay, *e.g.* bentonite, with the developed montmorillonite structure, their microscopic channels being entirely filled with other silicates. In such cases the leaching process must be carried out by means of concentrated and strong acids. (3) Bauxite, the exterior surface of which causes a desulphurization and decolorization of oils. Since water content weakens the sphere of activity calcination at 400–600° C. must be carried out. Exceeding this temperature range destroys the desulphurizing power owing to the splitting up of the aluminium and iron oxides. The degree of fineness of the bauxite is also of great importance in its effect on desulphurizing power. R. A. E.

647. Bleaching Clays. Part II. R. Fusstieg. *Petr. Eng.*, March 1937, **8** (6), 64.—Views of numerous investigators regarding the adsorption phenomenon are given, together with the author's opinion regarding their accuracy. He has found that the dissolved matter to be adsorbed from an oil by the adsorbent can exist in crystalloidal and colloidal form; however, they can exist as a single compound, both mixed in certain proportion. He also concludes, from work carried out on wax distillate and vegetable oil, that two processes occur during decolorization of oils: an adsorption of the adsorptive and a separation of the adsorptive as flocculents. In the first instance the microscopic channels will be filled with certain colouring matter, and in the second instance other colouring matter will be precipitated on the surface of the adsorbent. These observations explain why one clay will not bleach all oils to the same extent, and also why a complete bleaching of a given oil cannot be attained by

the use of one clay alone. Basic clays may be divided into two types: one in which the basic reaction is caused by the interior structure of the clay, *i.e.* a silicate, one of the components of which is a carbonate, and the other in which the microscopic structure is filled by carbonate. Treating acid oils results in a destruction of the microscopic structure in the case of the first type. When darkening of bleaching clay following the decolorizing process occurs, it is due to catalytic action of certain iron and aluminium salts polymerizing certain unsaturated hydrocarbons. These salts may also give rise to discoloration of a treated and decolorized oil product, *e.g.* gasoline, due to formation of certain unknown active unsaturated hydrocarbons capable of acting as polymerization catalysts.

The adsorption of colouring matter by an adsorbent does not occur immediately, but requires at least 10 minutes. The bleaching effect will not be altered unless duration exceeds 30 minutes, after which it decreases. Long duration of the action also increases the acid value of oils, especially in the case of artificially-activated earths containing a high percentage of water. The effect of temperature is small. As regards adsorption effect, the order is: unsaturated hydrocarbons, oxygen and nitrogen compounds, aromatics, naphthenic and paraffinic hydrocarbons. The greater the complexity of the molecular structure, the stronger is the adsorption. A favourable adsorption process thus requires bleaching clays of the proper microscopic structure, as well as the proper chemical composition for each type of the dissolved impurities that are to be adsorbed from the oil. Proper mixing of clays is also very important.

R. A. E.

648. Patents on Plant. Foster Wheeler, Ltd. E.P. 461,405, 16.2.37. Improved fractional distillation apparatus. W. S. E. C.

Chemistry and Physics of Petroleum.

649. Table of Specific Gravity Correction Factors for Petroleum Oils. E. S. L. Beale. *J.I.P.T.*, 1937, **23**, 213–219.—A standard table of specific gravity correction factors for petroleum oils, based on the Bureau of Standards Circular No. 154, is given and shown to give the same results as those given by the more elaborate tables of the Circular. Attention is directed to errors that may occur in using the A.S.T.M. Abridged Volume Correction table. G. R. N.

650. Aniline Points of Hydrocarbons. E. B. Evans. *J.I.P.T.*, 1937, **23**, 220–225.—A résumé of the data on the aniline points and critical solution temperatures in aniline of paraffins, naphthenes and unsaturates, with some discussion on their use in analysis. G. R. N.

651. Chemical Composition of Cracked Gasoline. N. A. Orlov. *Khim. Tver. Topliva*, 1935, **6**, 800.—Unrefined cracked gasoline was extracted with 7% sulphuric acid, and the extract was concentrated. After saturation with alkali, the concentrate was steam distilled, which caused a considerable evolution of NH_3 and easily volatile bases, as well as water-insoluble oily bases. The latter, after ether extraction, were distilled over at 120–250° C. and had a sharp pyridine odour, the specific gravity being 0·923/15° C. Precipitates were obtained with $CdCl_2$ and $HgCl_2$. Further fractionation and tests indicated that these bases were low-mol.-wt. homologues of pyridine formed by thermal decomposition of nitro-compounds present in the original oil. Redistillation of the fraction boiling at 240–245° C. and treatment with picric acid gave a crystalline picrate from which β-methylnaphthalene was separated.

For. Petr. Techn.

652. Separation of Unsaturates from Cracked Gasolines. P. S. Panyutin and E. Y. Rabinovich. *Khim. Tver. Topliva*, 1936, **7**, 154.—Separation of olefins was accomplished by bromination according to the method of Sachanov and Tilicheev. The bromides were debrominated by the Sn–Cu reagent in alcohol by a modified method of Gladstone and Tribe. Control experiments with straight-chain olefins showed the

absence of polymerization and isomerization, but further investigation is needed to ascertain the behaviour of *iso*-olefins, and other unsaturates. Twenty-one references.
For. Petr. Techn.

653. Physical Characteristics of Multi Ring Hydrocarbons. W. L. Nelson. *Oil & Gas J.*, 18.3.37, **35** (44), 46.—Data are given on the mol. wt., sp. gr. at 60/60° F., boiling point, melting point, heat of combustion, Saybolt viscosity at 100° F. and 210° F. and viscosity index of 21 naphthalene and anthracene derivatives. Not all are definitely known to occur in petroleum, but the data are likely to be of value for comparative purposes. C. L. G.

654. Complex Benzene Hydrocarbons. W. L. Nelson. *Oil & Gas J.*, 18.2.37, **35** (40), 60.—The formulæ, structures, mol. wts., sp. gr. at 60/60° F., boiling points, melting points, heats of combustion, viscosities S.U. at 100° F. and 210° F. and viscosity indices of a number of complex benzene derivations ranging from C_{24} to C_{40} are tabulated. References are given to the sources of the data used in compiling the table. R. A. E.

655. Influence of Surface Impurities on the Measurement of Interfacial Tension. E. Vellinger and A. Grégoire. *Ann. des Comb. Liq.*, 1937, **12**, 37–39.—The interfacial tension between liquids is lowered according to the impurities present; thus the least refined mineral oil lowers this characteristic more than a highly refined oil.

Curves are shown illustrating how the interfacial tension between a highly refined oil and a water solution, the surface of which has been contaminated with various mineral oils, varies according to the surface tension of the contaminated surface.
T. C. G. T.

656. Chemical Composition of Petroleum Fractions. Yu. K. Yur'ev and P. I. Zhuravlev. *Oil & Gas J.*, 11.3.37, **35** (43), 65.—A comparison has been made of two established methods of determining the chemical composition of narrow petroleum fractions and applied to an examination of fractions from various Russian crudes. The two methods follow the usual lines for the determination of aromatics and paraffins, but differ in the determination of the hexahydro-aromatic and pentamethylene hydrocarbons. In one case the hexahydro-aromatics are determined by dehydrogenating the dearomatized residue, and the pentamethylenes by the aniline point of the dearomatized dehydrogenated residue. In the other case the total naphthenes are first determined after removal of the aromatics, and the hexahydro-aromatics by dehydrogenation and the pentamethylene hydrocarbons by difference.

Comparative data on various types of Russian crude oil fractions differ considerably in their content of pentamethylenes and paraffins. Check calculations were therefore carried out using artificial petroleum fractions from individual hydrocarbons. In addition, a check was made of the Zelinskii method of determining hexahydro-aromatics by catalytic dehydrogenation, and of the Zelinskii and Kazanskii method of determining pentamethylenes by conversion of aliphatics by destructive dehydrogenation.

From the data obtained it was determined that the former of the two methods of chemical analysis given was more accurate than the latter. The Zelinskii method of catalytic dehydrogenation was found to be sufficiently accurate for fractions below 300° C. For hydrocarbons boiling between 150° and 300° C. Carpenter's coefficients for naphthene hydrocarbons are considered inaccurate, as the percentage composition obtained by computation differs from that of the hydrocarbons actually used in the synthetic fractions. C. L. G.

657. Chemical Composition of Surakhany Gasoline. P. S. Panyutin and E. N. Firsanova. *Khim. Tver. Topliva*, 1935, **6**, 801.—By the dehydrogenation method (Pt on coal) it was found that chiefly Surakhany gasoline (octane no. 74–78) is composed of the following hydrocarbons; 20·8% methyl*cyclo*hexane, 9·3% *cyclo*hexane, 5·1% ethyl*cyclo*pentane, 7·9% dimethyl*cyclo*hexane, 6·5% methyl*cyclo*pentane. *m*- and *p*-xylene were separated from the fraction boiling at 118–134° C., but the separation of pure *o*-xylene was not successful. The separation of tertiary hydrocarbons is

possible only with a great loss of product. The presence of *n*-heptane and 2:2-dimethylpentane is also very probable. A description of the lab. rectifying column and details of analyses are given. For. Petr. Techn.

658. Properties of Simple Benzene Derivatives. W. L. Nelson. *Oil & Gas J.*, 4.2.37, **35** (38), 39.—Data are given on the mol. wt., sp. gr. at 60/60° C. boiling point, melting point, latent heat and heat of combustion of 17 simple benzene derivatives from benzene to hexamethylbenzene. Notes on the general system of nomenclature of the four types of hydrocarbons are also included. C. L. G.

659. Kinetics of Bromine Addition to Olefinic Compounds. P. N. Robertson, N. T. Clare, K. J. McNaught and G. W. Paul. *J.C.S.*, March 1937, 335–343.—The conclusion of earlier workers that bromine addition is kinetically bimolecular is disputed, and the present paper shows that there are three main possibilities: (1) unimolecular surface reaction due to impacts of bromine molecules, with rising or falling bimolecular rate coefficients according to conditions;

(2) homogeneous termolecular reactions;

(3) homogeneous bimolecular reactions with catalysts, but obscured by various disturbing influences.

In general, bromine additions in acetic acid are termolecular, whilst in carbon tetrachloride the reaction is mainly heterogeneous.

The paper also describes the influence of hydrogen bromide and water on brominations. W. E. J. B.

660. Systems of Sulphur Dioxide and the Isomeric Xylenes. W. F. Seyer, K. Martin and L. Hodnett. *J.A.C.S.*, 1937, **59**, 362–363.—This paper describes a series of freezing-point measurements which were made on the systems sulphur dioxide and *o*-, *m*- and *p*-xylene.

The data show each system to have only one eutectic. Thus there is no indication of compound formation. The calculated latent heats of fusion when compared with the experimental values show that the *para* and *meta* solutions deviate considerably from the ideal. W. E. J. B.

661. Heat Capacity of Ethane from 15° K. to the Boiling Point. R. K. Witt and J. D. Kemp. *J.A.C.S.*, 1937, **59**, 273–276.—The heat capacity of solid and liquid ethane has been measured from 15° K. to the boiling point (184·1° K.). The melting point of ethane has been determined to be 89·87 $\pm$ 0·1° K., and the heat of fusion was found to be 682·9 cals./mole.

At the boiling point the heat of vaporization was determined as 3514 cals./mole. At the boiling point the entropy of ethane gas was calculated from the above data to be 49·54 e.u., whilst at 298·1° K. the entropy was 54·85 e.u. W. E. J. B.

662. Spontaneous Ignition under Pressure of the Simpler Aliphatic Hydrocarbons, Alcohols and Aldehydes. G. P. Kane, E. A. C. Chamberlain and D. T. A. Townend. *J.C.S.*, March 1937, 436–443.—The paper contains a description of the apparatus and procedure used to determine the ignition temperatures of various mixtures of hydrocarbons, alcohols and aldehydes, with air, at pressures ranging from atmospheric to 30 atmospheres.

A brief account is given of previous investigations on the influence of pressure on the spontaneous ignition of paraffin hydrocarbon/air media, indicating the relationship between ease of ignition in a low-temperature system at about 300–350° C., and the knocking propensities of the fuels concerned as observed in engine practice.

The present paper shows that in the ethane series ease of ignition is in the order aldehyde > alcohol > paraffin; in the propane series the same order is found, but the time lags for the alcohol are greater than for the paraffin. With the paraffins containing five or more carbon atoms the order is paraffin > alcohol. W. E. J. B.

663. Catalysis in Hydrocarbon Chemistry. Parts IV to VII. R. H. Griffith. *Trans. Faraday Society*, 1937, **33** (3), 405.—Benzene, *cyclo*hexane and hexane are adsorbed

by molybdenum oxide catalysts at temperatures as high as 450° C.; the present investigation was therefore carried out to compare the behaviour of various other metals and metallic oxides under similar conditions. Comparative data are presented for the adsorption of hexane on eighteen catalysts at temperatures varying from 20° to 450° C. Several types of adsorption of hexane may occur, varying in intensity, velocity and character. There is also little doubt that activated adsorption occurs, although when decomposition takes place the effect is marked. Adsorption may lead to one of four results:

(1) Vigorous decomposition causing extensive deposition of carbon on account of secondary reactions brought about by adsorption of primary reaction products;
(2) Decomposition involving loss of hydrogen from the molecule;
(3) Decomposition by loss of methane;
(4) Retention of the molecule without decomposition.

Catalytic activity is therefore always accompanied by adsorption, but the existence of adsorption does not necessarily involve activity.

A wide range of promoters has been examined in order to determine whether any regularity exists in the optimum concentration of these substances. When a molybdenum oxide catalyst is promoted by the addition of another oxide, the concentration of the latter affecting the greatest activity was found to be the same in every case. The amount of promoter required is a characteristic of the catalyst, and not of the promoter oxide employed. For promoters used in the metallic state, the concentration required is one half that which is necessary when the oxide is used. The prediction of the proper concentration of any promoter is thus possible, when that of any single one has been established. The significance of these results in the general theory of catalysts is discussed.

The use of promoted molybdenum catalysts for the conversion of phenol into benzene is next discussed. The optimum concentration of promoter required for this de-oxidation is different from that required in the case of hexane decomposition, and is slightly dependent on the promoter employed.

The last section of this paper deals with carrier action and molecule size. In this connection the dehydrogenation of dekalin, decane, hexane and *cyclo*hexane in contact with various catalysts at ordinary pressures has been studied. The catalysts used were titanium oxide, copper oxide, and chromium oxide, whilst in almost every case the carrier was pure magnesium oxide (in some cases, molybdic acid or china clay). The results obtained indicate that:

(1) The most active catalyst does not necessarily have the largest number of active centres.
(2) The lowering effects observed with carriers cannot be due to compound formation with the catalyst, as similar results are given by substances of widely different character.
(3) With a catalyst containing a large number of active centres, the addition of a carrier will produce a decrease in activity at a concentration which depends on the size of the reacting molecule.
(4) Addition of promoters does not increase the number of active centres, but produces a surface of a different type from that of the pure catalyst.
(5) Catalytic activity for an oxide catalyst depends on the degree of reduction; this type of change is associated with visible colour differences.
(6) A carrier may produce an initial increase in the activity of a catalyst by prevention of sintering. H. E. T.

664. Formation of Benzene in the Radiochemical Polymerization of Acetylene. W. Mund and C. Rosenblum. *Journ. Phys. Chem.*, 1937, **41**, 469.—Absorption spectra of acetylene polymerizing under the influence of radon have been photographed. For both alpha-ray and beta-gamma-ray reactions the formation of benzene has been demonstrated. Cuprene is not the only polymer produced in appreciable quantities, since by freezing in a carbon dioxide–acetane mixture a solid was obtained, which proved to be chiefly benzene. The benzene appears as the result of a reaction which proceeds simultaneously with the formation of cuprene. H. E. T.

665. Flammability of Propane–Air Mixtures. H. W. van der Hoeven. *Ind. Eng. Chem.*, 1937, **29** (4), 445.—The limits of flammability of propane–air mixtures under reduced pressure have been determined. H. E. T.

666. Drying Oils and Resins. T. F. Bradley. *Ind. Eng. Chem.*, 1937, **29** (4), 440.—No experimental work is described in this paper. It is devoted to a new discussion of the mechanism of drying phenomena, and contains many valuable ideas. Knowledge gained from the study of synthetic polymerides has been found applicable to many of the phenomena which have been observed in the case of natural substances of polymerizable nature. The "drying" of certain oils and resins is typical. While primarily physical, the drying of oils and resins can be definitely related to chemical reactions which, in their usual form, involve oxidation. The specific nature of these chemical reactions is indicated to be of less importance than the functionality equivalents of the reactants. Drying under the influence of chemical reactions is supposed to be determined by these functionality equivalents, and requires the transformation of a linear monomer or its polymeride to a three-dimensional polymeric form. Functionality concepts are revised and extended in order to permit of their legitimate application in future work. Active functionality has been differentiated from potential functionality, and further the influence of ring closure, whether by mono- or bi-molecular reactions has for the first time received consideration as regards its applicability to the phenomena of drying. Degree of "functionality" is understood to be the effective number of bonds or points of intermolecular attachment.

H. E. T.

Analysis and Testing.

667. Spectrographic Analyses of Oil-Well Brines. F. H. Emery. *Oil & Gas J.*, 4.3.37, **35** (42), 53.—The results of semi-quantitative spectrographic analyses of six Oklahoma oil well brines are reported and discussed. A hot pure carbon electrode was first used as a blank, and immediately after extinction 0·1 c.c. of the brine added so that it evaporated to dryness at once. The electrode and sample were then burned with a 10-amp. D.C. arc for 40 seconds, the light obtained being passed through a quartz Littrow-type spectrograph, using two exposures in order to record the spectrum from 2400 to 7000 Angstrom units. Comparison spectra of two brines samples, together with the iron arc, were produced with a three-aperture diaphragm over the spectrograph slit. Estimation of the amount of elements present by examination of the number and intensity of the lines has been shown by experience to give errors of 100%. However, by utilizing recently developed technique, together with internal standards and means of photographic plate calibration, all the minor constituents in an oil well brine could be determined with an error of 5% or less.

The analyses given indicate a surprisingly high figure of Sr (780–1100 parts per million), these values being only exceeded by Ca, Mg and Na, which were too high to estimate. Previous assumptions that Ca precipitates obtained in chemical analyses of brines contained a negligible amount of Sr may therefore be misleading. The K content, however, is negligible, so that it does not effect the Na determination.

It is suggested that spectrographic analyses affords means of distinguishing or correlating brines found in or adjacent to oil formations, whilst knowledge of the rare elements present should be of great value in detecting the source of casing leaks. More intensive spectrographic analysis of oil well brines and connate waters may bring to light new relationships which are not now indicated. C. L. G.

668. Laboratory Purification of Gases by Fractional Distillation. H. S. Booth and A. R. Bozarth. *Ind. Eng. Chem.*, 1937, **29** (4), 470.—This paper describes a new type of equipment for the laboratory purification of gases by fractional distillation. The equipment is efficient, and comparatively easily constructed; it is automatic and comprises a low-temperature fractionating column with accessories, a reflux cooling head for constant-pressure fractionating columns operating on solid carbon dioxide being described. A method for checking the reflux ratio is given, which is applicable to any fractionating column. An apparatus and method for measuring the melting point and vapour pressure are reported. By means of the apparatus described, the

method of manipulation being given in detail, gases may be purified to a high state of purity such as is necessary for the determination of physical constants and research. H. E. T.

669. Testing for Sludge Formation in Mineral Transformer Oil. F. M. Clarke and E. A. Snyder. *Proc. A.S.T.M.*, 1936, **36**, Part II, 568–587.—This paper constitutes a summary of the results obtained up to the present time by A.S.T.M. Committee D. 9 on Electrical Insulating Materials.

The goal of the present investigation has been the establishment of a testing procedure which is able to indicate clearly and accurately the sludge-forming characteristics of mineral oil. To this end a sludge accumulation test has been developed. In brief, this test consists of heating 25 mls. of mineral oil contained in a 50-ml. capacity Pyrex glass vessel, 6 inches in height and 1 inch in diameter. Five such tubes are immersed in a heavy mineral oil contained in a 600-ml. Pyrex glass beaker, and the whole is placed in a test oven maintained at 120° C. After prescribed intervals of time, a tube is removed, allowed to stand for 24 hours at room temperature, and the oil diluted with an amount of A.S.T.M. precipitation naphtha, equal to 75–80% of the oil volume. The solution is then centrifuged at 1800 r.p.m. for 20 minutes, by decantation the sludge is washed with naphtha and finally dried, the tube and sludge being weighed. The tube is then freed from sludge and, after suitable drying, re-weighed in order to obtain the weight of the sludge formed, which is expressed as a percentage by weight of the original oil.

The sludge-accumulation test appears capable of distinguishing between oils of varying sludging quality only if carried sufficiently far to produce at least as much as 0·05% sludge by weight. This applies whether or not copper be used as an accelerator of the oxidation. Without copper, the test appears more easily reproduced, but must be extended for at least 35 to 45 days at 120° C. under the conditions outlined. With copper, a decision in as short a time as 9 days at 120° C. is possible with oil of a quality approaching the average sludge resistance of the usual American transformer oil. With oil definitely of an inferior quality, both tests are capable of application in an even shorter oxidation time. Not all oils appear affected to a like degree in contact with copper during the oxidation. In general, the oils of the usual transformer type are more greatly accelerated by copper than are the oils considered to be of less sludge resistance in the absence of copper. The result is that the presence of copper may so modify the sludging reactions as to mask the differences clearly evident when the same oils are sludged in the absence of copper. The significance of this fact can only be gauged when the investigation reaches that stage when the oils will be examined from the viewpoint of actual transformer service.

The variation in sludge results obtained in different laboratories, even with the larger amounts of sludge formed, are of such magnitude that the sludge-accumulation test is at present not considered as satisfactory for standardization. Those factors which affect the sludging of an oil, and which are responsible for the variation in sludge results reported by different laboratories, are being investigated and eliminated. Progress has been definitely made as a result of the co-operative work of the various laboratories represented in these activities. It is concluded that continued progress may be expected to the end that a well-grounded test, capable of giving reproducible results and definitely related to the actual commercial use of transformer oils, will be established.

In the discussion which followed, Stäger pointed out that sludge formation was one among several other products of the reaction, and that, in his opinion, those products of oxidation by air at high temperatures which were not precipitated as sludge and had the character of peroxides were far more important. It was contended that such products were very dangerous, for the reason that they destroyed the organic insulation materials of the transformer within a short time. W. E. J. B.

670. Use of X-Rays in the Identification and Estimation of Mixtures of Aliphatic Compounds. S. H. Piper. *J.S.C.I.*, 1937, **56**, 61T–66T.—This paper contains a concise summary of methods of crystallographic investigation using X-ray defraction pictures.

The application of the results of such methods is described with many examples. A complication in the interpretation of X-ray results is due to the polymorphism

exhibited by most aliphatic substances. It is usual to find that a particular compound crystallizes in two or more modifications, the modification adopted being primarily due to temperature, but influenced also by the nature of the solvent and the presence of impurities.

In investigating complex mixtures of natural wax substances, use is made of melting points, mol. wts., molecular spacings and transition temperatures.

This paper contains considerable data on mixtures of long-chain paraffins, including melting points, transition temperatures and molecular spacings, as well as similar data on the derived acids and alcohols. W. E. J. B.

671. Temperature of Saturation of Distillates with Paraffin. N. F. Bogdanov and N. S. Serebryakova. *Grozn. Neft.*, 1935, **5** (3), 68.—The product to be tested is placed in a 15–17-mm. test-tube (140–170 mm. long) to a height of 20 mm. A thermometer is placed through the cork in the test-tube so that the bulb is close to the bottom. The test-tube is heated to 40–45° C., then placed in a glass jacket immersed in ice-water. The cooling product is agitated by the thermometer, and the temperature at which turbidity appears is taken as the pour point. The jacketed space may contain some $CaCl_2$ to remove moisture from the air and facilitate the reading of the thermometer. For. Petr. Techn.

672. Viscometer Suitable for Materials of High Viscosity. A. A. Clark and H. J. Hodsman. *J.S.C.I.*, 1937, **56**, 67T–70T.—A concentric cylinder viscometer with a range of, say, 50 to 10^6 poises at any one temperature. Curves obtained by plotting torque in degrees against time in minutes, or against velocity of rotation (degrees per minute), show differences between perfect or abnormal fluids. For perfect fluids viscosity is proportional to θ/ϕ (where θ = torque in degrees and ϕ = velocity of rotation of the inner cylinder). Log $K\theta/\phi$ (where K = constant dependent on dimensions of instrument) plotted against log of velocity of rotation gives straight lines parallel to the horizontal axis for perfect fluids. In the case of abnormal fluids the line is inclined to this axis, the slope of the line indicating the degree of abnormality. Correction for the end effect of the cylinders is derived graphically. Equations are given relating viscosity and the dimensions of the instrument, whilst results on castor oil at various temperatures are tabulated and compared with results obtained by previous workers. Advantages claimed are wide range (down to as low as 10 poises and higher than 5×10^6 poises by suitable choice of dimensions), rapid temperature equalization, smallness of sample needed and applicability to thixotropic or plastic fluids. Incidentally, pitches are apparently perfect fluids. J. L. T.

673. Method of Measuring the Rheological Properties of Materials of Great Consistency such as Asphalts. E. Thelen. *J. of Applied Physics*, 1937, **8** (2), 135.—The rheological properties of asphalts can be determined by using the A.S.T.M. penetrometer if a succession of penetration readings is made without touching the needle or sample between each reading. The first penetration in hard asphalts, and the first several in soft give erratic results.

Expressing the mobility of the sample m, as

$$m = a/(b - f)$$

it is found that for penetrations greater than 43

$$a = \frac{7{\cdot}854 \times 10^{-5}\,(P_f - P_i)}{t}$$

$$b = \frac{0{\cdot}098 \times 10^4\,W}{0{\cdot}001571\,(P_f + P_i) - 0{\cdot}0521}$$

P_f = final penetration during interval t in decimillimetres.
P_i = initial penetration during interval t in decimillimetres.
t = time interval in seconds.
W = wt. of needle and instrument head in grams.

It is found that log m varies linearly with temperature, and that yield values for asphalts from a given crude stock (f in the equation above) vary linearly with the

per cent. asphaltene content, the concentration of zero yield value being 21·8%. On ageing an asphalt increases in yield value and decreases in mobility. P. D.

Motor Fuels.

674. Fuels for Petrol Engines. F. H. Garner. *Petr. Times*, 13.3.37, **948**, 351.—The desirable characteristics of gasoline are discussed under various headings, viz. (*a*) ease of starting. This depends principally on the volatility of the fuel, and the 10% end-point is a reliable guide. It is a difficult characteristic to assess owing to the diversity of engine and fuel induction system design. (*b*) Warming up and acceleration. These depend more on the design of the induction system than on the properties of the fuel. They depend on the mixture ratio, and since the control of this ratio is easier with a more volatile fuel, volatility is again of importance. The 50% end-point appears to be an index of these characteristics. (*c*) Vapour lock is a greater hazard on commercial vehicles than on private cars, owing to smaller free space, and consequent higher prevailing temperature, under the bonnet. The relatively small range of temperature experienced in England render the hazard small, but it is nevertheless important that the temperature of the fuel-supply system, up to the exit from the carburettor, should be kept to a minimum. (*d*) Dilution is usually of the order of 5% vol., a figure reached in about 500 miles and held by the operation of the crankcase breather. The 90% end-point is considered to be the deciding factor. (*e*) Anti-knock rating. Recent advances in engine design have been responsible for an increased sensitivity to changes of atmospheric temperature from the point of view of the tendency of the engine to "pink." Engine speed and fuel/air ratio may effect an apparent fuel "depreciation," in that road performance tests may indicate considerably lower octane ratings than the C.F.R. method. (*f*) Economy. Mileages are below theoretical owing to the necessity of using mixture ratios higher than theoretical. Proper engine adjustments are the principal contributory factors in economy. All these characteristics, except the last, have been improved considerably in recent years. Economy has in some cases deteriorated, due, chiefly, to the demand for increased acceleration and ease of idling. A brief description is given of a chassis dynamometer outfit for the investigation of fuel and lubricant performance. H. G.

675. Effect of Lead on Aviation Gasoline. Veksler and Zabryanskii. *Novo. Tekhn.*, 1936, **26**, 18.—The effect of addition of lead tetraethyl to various aviation gasolines was studied. The octane number of Grozny aviation gasoline was raised by 10 and 18 units by the addition of 0·5 ml. and 2 ml. lead, respectively. Similar additions to Maikop gasoline raised the octane number by 9·5 and 16·5 units. Mixtures containing Grozny gasoline had a lead response approaching this product. Alcohol decreased the response by 4–6 times. A blend of 35% Maikop gasoline and 65% Baku gasoline containing 2 ml. lead had an octane number of 87. For. Petr. Techn.

676. Stabilizer for Alcohol-Gasoline Mixtures. M. M. Minin. *Novo. Tekhn.*, 1936, **26**, 17.—A primary butyl alcohol obtained in the Leningrad synthetic rubber plant has satisfactory stabilizing properties. It contains not more than 1% water and does not form gum, although it has a somewhat high acidity. However, the acidity decreases to a permissible level in the alcohol–gasoline mixture. A primary butyl alcohol obtained in the Romodanov synthetic rubber plant has better stabilizing properties. It contains about 0·5% water, increases the octane number from 66·3 to 80 (for a mixture gasoline 70%, ethyl alcohol 15%, and butyl alcohol 15%) and has a lower acidity than that from the Leningrad plant. For. Petr. Techn.

677. High Octane Number Gasolines. V. I. Karzhev, M. G. Severyanova and A. N. Siova. *Khim. Tver. Topliva*, 1936, **7**, 559.—The effectiveness of the reaction of catalytic dehydrogenation in the presence of Cr_2O_3 and CuO, activated with BaO, $Cr + H_3PO_4$, $Cr + Mo_2O_3$ and Cr and Cu and H_3PO_4 catalysts was checked on tetralin and dekalin. The most effective catalysts were $Cr + Mo_2O_3$ and Cr and Cu and H_3PO_4. These hydrocarbons were simultaneously dehydrogenated and ruptured. Thus, tetralin, after a single treatment with Cr and H_3PO_4 at 550° C., yielded a 5%

fraction b.p. 130–150° C., consisting chiefly of xylenes and higher-boiling fractions containing naphthalene. Under the same conditions 58·4% of the dekalin was cracked. The yield of hydrogen was 87% from tetralin and 34% from dekalin. The formation of aromatics from paraffin hydrocarbons under the same experimental conditions was checked with *n*-decane, *iso*decane and *n*-heptane. *n*-Decane yielded a gasoline containing 44·8% aromatics, 8·34% naphthenes, 24·6% unsaturates and 22·2% paraffins. The gas produced contained 33·43% hydrogen, 24·06% unsaturates and 32·67% saturates. *iso*Decane gave a gasoline containing 18% aromatics. Thus, ring formation accompanied by a simultaneous dehydrogenation of paraffin hydrocarbons was proved. For. Petr. Techn.

678. Use of Gasoline Inhibitors. M. Volef and O. Vasileva. *Nov. Neft.*, 1936, **3** (14), 6.—A cracked gasoline, stable for 6 months, was obtained by adding 0·014% α-naphthol and 0·07–0·014% wood tar from deciduous trees, whilst a cracked gasoline treated with 1% H_2SO_4 and addition of 0·013% α-naphthol was stable for 11 months. Good results were also obtained with a cracked gasoline subjected to an alkali treatment, re-distillation and addition of α-naphthol. For. Petr. Techn.

Lubricants and Lubrication.

679. Principles of Solvent Dewaxing. M. B. Thi, L. C. Strang, T. G. Hunter and A. W. Nash. *J.I.P.T.*, 1937, **23**, 226–252.—An attempt to investigate dewaxing on a basis of graphical equilibrium representation and computation itemized under equilibrium in a simple three-component solid-liquid system, oil–wax-solvent equilibria, dewaxing computations, experimental determination of the equilibrium diagram, and classification of solvents. G. R. N.

680. Quantitative Determination of Adulteration of Lubricating Oils by Means of Identifiers. Part III. S. Fischer. *Petr. Eng.*, March 1937, **8** (6), 101.—The substances so far mentioned proved unsatisfactory, especially from the quantitative point of view, when applied to analysis of used engine oils. The use of metallic oleates, palmitates and stearates for this purpose was examined, and eventually nickel oleate was chosen.

The procedure employed was to heat 2000 gals. of oil in a suitable blender to 150° F. with agitation. 500 gm. of nickel oleate in an iron ladle heated to 95–140° C. was then introduced and agitation at 150° F. continued for 15–30 minutes, depending on the viscosity of the oil. The nickel content of an oil under test is determined by ashing, extraction with hot acid and determination of nickel content of the extract. Since the oleate accumulates in the crankcase, however, the idea of a quantitative test for used oils was abandoned. A satisfactory qualitative test based on the characteristic pink colour of the nickel salt of dimethylglyoxime was, however, developed, and it appears that the test might be used as a quantitative one if employed on lines similar to those already described. For legal purposes the use of any one identifier alone is not to be recommended, owing to possibility of identification by other parties. The use of several identifiers is advised, as detection of all of them is less likely. A method based on the combined use of oil brown M and phenolphthalein–hexalin identifiers is described. There is an added advantage in employing two identifiers such as these, since the percentage of adulterant can be double-checked. Tests showed that accuracy of blending could be sufficiently well controlled to avoid important variations between blends.

Analyses of untreated and identified oils show little differences, but slightly higher colours, Sligh numbers and carbon residues in the case of the identified oil. Actual tests on specially prepared samples showed that estimation of adulteration was within the accuracy of 5–10% demanded by a certain company. R. A. E.

681. Propane Dewaxing of Grozny Cylinder Oil. A. M. Ravikovich and E. S. Lysenkova. *Grozn. Neft.*, 1935, **5** (3), 55.—The cylinder oil distillate ex mixed base crude yielded a ceresin (18·2%) of penetration 8 at 30° C. and a refined oil of pour point — 20°

C. and viscosity $3{\cdot}4/E_{100}$. The residue cylinder oil gave 14% asphalt, 17–20% ceresin and 41–45% refined oil. For. Petr. Techn.

682. Effect of Solvent Extraction on Aromaticity of Lubricating Oils. G. H. von Fuchs and A. P. Anderson. *Ind. Eng. Chem.*, 1937, **29** (3), 319.—The purpose of this article is to describe a rapid method for determining "aromaticity," and to indicate its relation to other oil properties, particularly in connection with the measurement of the improvement attainable on solvent extraction. In this connection the term "aromaticity" is used to indicate the nature and extent of the aromatic character of a lubricating oil. The importance of aromaticity as a characteristic oil property is discussed, and it is suggested that the progressive improvement attained on solvent extraction may be measured by the change in aromaticity which results. The rapid determination of aromaticity, the specific dispersion, operation of optical dispersion and specific gravity, is proposed. The principle and advantages of this constant are discussed in some detail, and specific dispersion values are correlated with chemical constitution, viscosity index, carbon residue, and oxidation stability of successive extraction stages on several types of lubricating oils.

The specific dispersions of thirty-four paraffinic, seventeen naphthenic, fifty-five aromatic, and fifteen polynuclear aromatic hydrocarbons are given; these compounds all being pure (there is an apparent error in the value 0·6654 given for the specific dispersion of di*iso*propyl).

A new instrument constructed and used by the authors for measuring specific dispersions is described. H. E. T.

683. Regenerating Motor Oils. I. G. Ignatovskaya. *Novo. Tekhn.*, 1936, **42**, 37.—A used oil, after settling at 70–80° C. for 6 hours, was mixed with 0·5% calcined Na_2CO_3 for 10–15 minutes and pumped into an electrically heated still. The oil was fractionated at 10–15 mm. into fuel, light oil, distillate motor oil and residual oil. The motor oil had a sp. gr. of 0·924/15° C. and viscosities of 11·4E and 1·88E at 50° and 100° C. respectively. For. Petr. Techn.

684. Canfield Lubricating Filtration Plant. J. C. Albright. *Refiner*, 1937, **16** (2), 78–80.—The plant is housed in a three-storey building with the clay-burning unit separate and adjacent, being connected by an elevator shaft. There are eight filters which are charged with 200 tons total clay, which is a specially treated grade. The throughput is 700,000–800,000 galls./month of lubricating oil using a 50 : 50 solution in naphtha. The complete operation, which is entirely mechanical, is described. G. R. N.

685. Olive Oil as a Motor Lubricant. M. Péru. *Ann. des Comb. Liq.*, 1936, **11** (6), 1071–1083.—At present, Tunisian law requires an incorporation of 20% of residual olive oil in lubricating oil, since the normal outlets for lamp oils and industry (*e.g.* cloth treatment and soap making) are insufficient. Apparently the pressed product is easily disposed of for table use. A Commission has been appointed to investigate certain difficulties (not defined) which have arisen in the use of the compounded lubricant. Preliminary tests in two Peugeot vehicles have indicated an increased consumption of the compounded oil, whilst evidence of gumming has been noticed, and an "odour of frying" inside the cab reported. These tests are being elaborated on three Citroen vehicles, one of which is being lubricated with a well-known mineral oil, and the other two with the same oil compounded with 20% of residual olive oil of less than 1% acidity. The tests will last for 40,000 km. with sump drainings at 2000 km. Measurements of wear will be carried out. Serious seizure of the piston heads of one of the two vehicles lubricated by the compounded oil has already been noticed.

In addition to the above-noted tests, a bench test and tests in a compressor and in two tractors are being undertaken. Visits to three oil works in Tunis are described, and a summary of previous work on pressed olive oil, together with a description of the present programme, is given. Since the production from the increased planting recently carried out is estimated to reach in a few years' time 100,000 tonnes per annum, and since only 3500 tonnes of lubricating oil are used annually in Tunis, it is pointed out that other outlets will have to be found besides compounding with mineral lubricating oils. J. L. T.

Asphalt and Bitumen.

686. Earth Mixing with Asphalt Emulsions. D. Haller. *Asphalt und Teer*, 1937, **37** (1), 5–7.—The article deals with the increase in the use of mixing emulsions for road construction, particularly for second-class roads, which have no very great amount of traffic to accommodate, together with suggestions for improving the technique of this type of construction.

A table is given showing the properties of typical emulsions, and a second table illustrates the method of calculating the amounts of stabilizer which must necessarily be added to the emulsion for various grades of earth. A formula is also included which connects percentage stabilizer, and particle size of that portion of the earth used which passes through a 200-mesh sieve. A. O.

687. Patents on Asphalt. A. P. Anderson and W. K. Nelson. U.S.P. 2,073,088, 9.3.37. Production of high-grade asphalt by blending an asphaltic substance containing over 30% of asphaltenes with a fraction of low viscosity index obtained by solvent extraction of a hydrocarbon oil.

G. T. Gambrill, Jr. U.S.P. 2,074,689, 23.3.37. Production of pitch from coal-tar. W. S. E. C.

Special Products.

688. Modern Developments in Research on Insecticides. Part I—General Survey. F. Tattersfield. *J.S.C.I.*, **56**, 79T–85T.—A survey giving many references to the literature. Insecticides are classified, their mode of action is discussed and methods of evaluation are briefly described. Tar distillates and petroleum oils are given due comment and the latter are acknowledged as one of the foremost insecticides. The main applications of, and objections to petroleum, are very briefly mentioned. T. C. G. T.

689. Modern Developments in Research on Insecticides. Part II—Insecticidal Plant Products. J. T. Martin. *J.S.C.I.*, **56**, 85T–91T.—A survey giving many references to the literature. Various insecticides from plants are discussed and the proposed structural formulæ of some given. The use of pyrethrum and derris extract in household sprays are mentioned. Atomized paraffin extracts of pyrethrum are being used against coffee pests in Kenya, and certain warehouse pests are being controlled by a pyrethrum extract in white oil. Pyrethrins, the active compounds of pyrethrum, may be rendered inactive and insoluble in petroleum by forming a coating of oxidized acids. Anti-oxidants are being used to combat this fact. The action of pyrethrins on insects is outlined. T. C. G. T.

690. Naphthenic Acids Direct from Crude Oil. V. Biske. *Refiner*, 1937, **16** (2), 72–77.—Peruvian Crude is soda washed prior to distillation at the Manchester refinery of Lobitos Oilfields, Ltd. The soda extract contains sodium naphthenates which are converted into naphthenic acids by treatment of the extract with sulphuric acid. The unrefined acids, which represent 0·25% of the crude, are separated, and, if settled hot, contain 0·5% water and 26·3% unsaponifiable matter, whilst the acid value is 155. They are suitably refined by distillation with superheated steam in which the bulk of the unsaponifiable matter is removed first, then about 75% by wt. of crude naphthenic acids as determined by a decrease in the acid value, leaving an asphaltic residue sufficiently hard and resinous to serve as a base for bituminous paint. The crude acids now contain 15·6% unsaponifiable matter and have an acid value of 190. The acids are further refined by treatment with 10% of 10% sulphuric acid, water at 160° F., clay at 230° F. and filtration. The dilute acid wash decomposes the iron naphthenates formed in the distillation as the naphthenic acids attacked the iron condenser. Some comparisons of Peruvian and Russian naphthenic acids are given. G. R. N.

691. Patents on Special Products. A. Carpmael. E.P. 461,080, 9.2.37. Manufacture of addition products of acetylene and its hydrocarbon substitution products.

J. Y. Johnson. E.P. 461,497, 17.2.37. Manufacture of carbon black by partial combustion of gaseous-carbonaceous substances or gases containing the same, *e.g.* acetylene with oxygen or air.

I.G. Farbenindustrie A.-G. E.P. 461,604, 19.2.37. Stabilization of lead tetraethyl and anti-knock mixtures containing the same by suspending alkali metal fluorides in the lead tetraethyl for a considerable time at elevated temperatures. The undissolved residue is removed. W. S. E. C.

Detonation and Engines.

692. Improvements in the Economy and Output of Heavy Oil Engines. J. Calderwood. *D.E.U.A.* S. 137.—It is stated that there has been a marked improvement in the specific output of heavy-oil engines during recent years, with a corresponding improvement in fuel consumption. These assets have been gained generally without loss in reliability, life or repair cost, but in some cases there has been a sacrifice in lubricating oil consumption, and in others an improvement.

In examining how these improvements have been attained, the various features of the design are studied in relation to the manner in which they have enhanced the various qualities of the engine.

Suggestions for the modernization of existing engines are given.

The author does not consider that there will be marked improvements in fuel economy in the near future; improvements in specific output will depend largely on advances made in the materials of construction, especially those used for the wearing surfaces. J. G. W.

693. Operation and Maintenance of Marine Diesel Engines. S. B. Freeman. *D.E.U.A.* S. 136.—Attention is directed to the factt hat oil engines should not be operated at power outputs in excess of that at which they will run continuously without trouble; this limiting power may be below the rated power.

In discussing the oil fuel, the author gives details of troubles which developed in certain engines with some supplies of fuel, and suggests that the oil companies should make known the characteristics of their products.

Particulars of the manufacture of the various parts of the engine are given with the general trends towards improved designs.

Operating and servicing recommendations for the successful operation of marine diesel engines are included in full detail. J. G. W.

694. High-Speed Engine Indicators. E. S. L. Beale and R. Stansfield. *Engineer*, 26.2.37, **163** (4233), 240–241, and 5.3.37 (4234), 270–274.—The characteristics of engine indicator diagrams are discussed with particular reference to the petrol engine when running under smooth and knocking conditions. It is shown that the pressure–time diagram does not show up the combustion effects very clearly, and that the rate of change of pressure–time diagram is much to be preferred. It is explained that with many types of indicator there are difficulties in the way of obtaining this latter diagram, chief of which is the confusion and distortion introduced by spurious mechanical vibrations of the pressure element in the engine cylinder. Although these effects of vibrations may not be very noticeable on the pressure diagram, by the process of differentiation to obtain a rate of change of pressure diagram, the amplitude of vibrations is increased in proportion to their frequency, with the result that they may obscure the main diagram. The authors stress the importance of rigid mechanical design of the pressure units to avoid the introduction of unwanted vibrations.

Typical diagrams are given which show the advantages of the rate of change of pressure diagrams in detecting the onset of knocking and showing up the presence of detonation waves.

The effects of indicator passages are discussed, and a special design of passage is described which almost completely avoids the introduction of resonant vibrations, the "transformer" effect, and damping; and yet does not overheat the pressure measuring diaphragm: indicator diagrams are given which show that the special passage gives results which can scarcely be distinguished from those obtained with no passage at all.

When a long indicator passage cannot be avoided, a special insert is used, designed on similar lines.

A comparison is drawn between various types of pressure measuring elements, such as the carbon block, and quartz crystal, and the superiority of the electromagnetic system is substantiated by diagrams taken under similar operating conditions.

A special calibrating unit, designed for use with the Standard-Sunbury indicator, is described. The principle of operation is that of the balanced disc valve; on account of the electromagnetic method of measuring the movement of the disc, it has been possible to reduce its weight to 30 mgm., and the accuracy is, in consequence, of a very high order.

The authors conclude by outlining a few of the miscellaneous improvements that have recently been made to the Standard-Sunbury indicator and its equipment.

J. G. W.

695. Cathode-ray Oscillograph Applications. R. R. Batcher. *Instruments*, 1937, **10** (2), 49.—Methods of applying cathode-ray oscillographs to obtain the comparison of the magnetic properties of specimens of manufactured articles for production-control purposes. P. D.

696. Cathode-Ray Oscillograph Applications. R. R. Batcher. *Instruments*, 1937, **10** (3), 72.—Methods of applying cathode-ray oscillographs to the determination of ignition characteristics and pressure diagrams in i.c. engines. P. D.

697. Patents on Fuel Oil. W. A. Bristow and C. Buist. E.P. 461,320, 10.2.37. Fuel for compression ignition engines of the diesel type consisting of a high-boiling coal oil and ½–5% of nitroxyl ethylene chlorhydrin or bromhydrin. W. S. E. C.

Coal and Shale.

698. Fuels from Czechoslavakian Coals. E. Galle. *Petr. Zeit.*, 10.3.37. **33** (10), 2.—Four main methods of fuel production are detailed, namely, the Fischer water-gas synthesis to produce Kogasin, methanol production, the I.G. high-pressure hydrogenation process and extraction of coal with tetralin or hydrogen, with subsequent hydrogenation of the ash-free coal substance. These are all considered on their merits and diagrams of the plants are given.

In view of the large quantities of coal available in Czechoslavakia and a deficiency of petroleum, coal-tar oils are used as the source of liquid fuels, the hydrogenation process usually being applied. W. S. E. C.

699. "Dust-proofing" of Coal. Anon. *Chem. Trade J.*, 26.2.37, **100**, 184.—The dust-proofing of coal is now claimed to be an important and permanent feature of the coal industry in the U.S.A., and the 1935 output of oil-sprayed coal alone has been estimated at more than 6 million tons. The most common reagents in use at present are oils, oil emulsions and $CaCl_2$ solution. For coal treatment, oils are often considered the most satisfactory reagents, partly because they are less liable to be washed off by rain and are more convenient to use in freezing weather. Oils do not spread so readily on coke as on coal, and this difference may account for the frequent use of emulsions and $CaCl_2$ for coke treatment. From experimental evidence obtained with British coals by the Fuel Research Board, it appears that no difficulty is likely to be experienced in the treatment of coals of more than about 83% carbon content. The dust-proofing is in many instances short-lived, so a better understanding of the mechanism of the process is necessary in order to achieve greater permanence. R. A. E.

Economics and Statistics.

700. Fundamental Problems for the Future of the Rumanian Petroleum Industry. V. Patriciu. *Mon. Petr. Roum.*, 1937, **38**, 297–306, 387–394.—An article analysing the Rumanian petroleum industry and illustrating its great national value. Petroleum

was 24·7% of Rumania's total export trade in 1926, rising to 50·6% in 1935. 31% of Rumania's revenue was derived from the petroleum industry. The revenue and expenditure of the industry are tabulated. Public concern for her oil reserves is growing. The most reliable sources estimate reserves at 61,000,000 tonnes, or about 6 years' production at the present rate. There are, however, vast tracts yet to be prospected. Close government control is urged, and the position of private enterprise in relation to the State is discussed fully.

Legislation regarding petroleum by various governments, including that of Great Britain, is briefly summarized. T. C. G. T.

701. Organization of Research in the Petroleum Industry. J. H. Vermeulen. *J.I.P.T.*, 1937, **23**, 179–191.—A Paper with discussion dealing with the organization of the physical, chemical and related mechanical research work in a central research laboratory in the petroleum industry and giving some notes on reporting and supervision. G. R. N.

702. Research and Development Activities in the S.O.C. New Jersey Interests. W. C. Asbury and D. A. Shepard. *J.I.P.T.*, 1937, **23**, 192–196.—A Paper with discussion on the methods employed by the S.O.C. New Jersey and its affiliates to promote regular research and development, so that market demands may be forecast and fulfilled. G. R. N.

BOOK REVIEWS AND BOOKS RECEIVED.

Book Reviews.

Uber die Zusammensetzung von Erdölasphalten (On the Composition of Asphaltic Bitumen). By Dr. J. Oberbach and Dipl.-Ing. Pauer. Pp. 104. Allgemeiner Industrie-Verlag G.m.b.H., 1937.

The aim of the authors is to increase existing knowledge (which is not great) as to the relationship between the physical properties of asphaltic bitumen and its inner constitution. Such connection has been made by means of physical tests and chemical analyses of many samples.

The most illuminating advance towards the fundamental understanding of the nature of bitumen was the demonstration by Nellensteyn of the colloidal nature of the material and the mode of its formation. Basing himself on Wilhelmi's extension of Nellenstyn's ideas, and modifying Marcusson's method of analysis, Pöll published his method of quantitative separation, unchanged, of the four main constituents of bitumen—oil, petroleum resin (red), bitumen resin (brown), and hard asphalt (residue).

The brochure under review records the results of the examination of a number of bitumens by means of Pöll's method of analysis and the application of the tests for softening point, drop point, flow point, ductility, penetration, and loss on heating (stability). This has been done for three series of samples, each consisting of products of increasing hardness, and the results have been set out in a series of curves for each physical test, connecting together the results of the test, the hardness (penetration) and the chemical composition of the material. The three series were: the "V" series, consisting of standard commercial products; the "V^1" series, of the same standard hardnesses but produced by a single distillation, thus eliminating any effects of processing; and the "M" series, which were produced by vacuum distillation; and the curves are remarkably different.

It is not proposed to summarize the author's conclusions, as their proper value is only realized in association with the observations and discussions that lead up to them. One detail of possibly high significance might be given: there is some very important chemico-physical change occurring when the penetration of 80–100 is reached, because nearly all the curves of the V and V^1 series show a kink at that point. The interpretation is that some of the oil associated with the carbon micelle leaves it and passes into the continuous phase. This might be of high importance to users of such bitumen if their material is tending to alter its constitution.

The publication is of value for the fundamental character of the work, and it marks a definite stage of advance in the understanding of this most difficult subject. It is remarkable, too, for the wealth of analytical details that are given. It deserves and, indeed, demands most careful study. P. E. S.

Die Rotary-Bohrmaschinen und ihre Antriebe (Rotary Drilling Machines and their Propulsion). By Dipl. Ing. L. Steiner. Berlin: Laubsch and Everth, 1936.

This slim volume is mainly concerned with the power-aspects of rotary drilling, and scarcely mentions the subject of rotary drilling-tools. The author outlines the well-known elements in the make-up of a rotary rig and discusses the application of steam-engines, internal-combustion-engines and various types of electric motors to the propulsion of rotary table, draw-works and mud-pumps. Various devices for automatic regulation of the rate of feed of the drilling tools and for measuring borehole inclination are described. The treatment is condensed, but lucid, if perhaps a trifle academic.
B. K. N. W.

Catalytic Reactions at High Temperatures and Pressures. By V. N. Ipatieff. The MacMillan Company, New York, 1936. Pp. 786. Price 30*s*.

In an interesting Preface by Professor Willstaetter of Munich it is pointed out that Ipatieff's work is based on the great traditions of the Russian school of Mendeléef

and Markownikoff. His early work was concerned with the chemistry of hydrocarbons, and particularly the addition reactions of unsaturated hydrocarbons. The originality of his treatment was apparent in his work on the constitution and synthesis of *iso*-propene in 1897.

Ipatieff has been a pioneer throughout his scientific life. His researches on pyrogenesis and on catalytic hydrogenation are characterized by the wide scope of his choice of catalysts and by his introduction of very high pressures. Many of his results have laid the foundations for important technical advances.

During the last six years Professor Ipatieff has been working in Chicago in the laboratories of the Universal Oil Products Company, and the development of his researches on catalytic polymerization will be familiar to all petroleum chemists. Based on this work has sprung up in effect a new industry, the production of marketable and high octane motor spirit from what was hitherto a waste product.

The monograph actually is a collection and critical review of his investigations in the field of catalysis over a span of 35 years. As Ipatieff says, quite frankly, the book is to be regarded as his chemical autobiography. Therefore no particular attempt has been made to collate the literature or to discuss the work of his contemporaries. He is particularly insistent on his own pioneering researches, especially with regard to the application of high pressure, and he indicates that the present-day production of *cyclo*-hexane, tetraline, decaline and many other products is based on methods laid down by him in the first instance. He was the first to hydrogenate material in the liquid phase. He has developed hypotheses applicable to the catalysis of dehydration, polymerization, alkylation and isomerization, and a considerable amount of entirely new material is published here for the first time. The scope of the work can be appreciated from the following divisions: dehydrogenation; dehydration of alcohols, catalytic isomerization; hydrogenation; the effect of promoters; destructive hydrogenation; catalytic condensation; polymerization, destructive alkylation and the theoretical principles of catalysis. Of particular interest to-day is the Appendix that deals with the production of gasoline by the polymerization of olefines.

The monograph must not be regarded as a comprehensive study of all these various topics. Nor would the author desire it so to be regarded. It is in effect the personal work of a great investigator and as such it will be welcomed and valued.

A. E. D.

ERDOL-UNTERSUCHUNGSMETHODEN, Editor Dr. Erich Molnar, Publication No. 7 of the Austrian Petroleum Institute, Verlag fur Fachliteratur Ges.m.b.H., Vienna XIX, Vegagasse 4; pp. 167, with tables. RM. 10.

THIS book summarizes the testing methods employed in various countries for the individual products, gasoline, kerosine, gas oil, diesel oil, fuel oil and lubricating oils. It is a publication of the Austrian Petroleum Institute (of which the President is Professor Suida), and the book itself is edited by Dr. Erich Molnar.

As typical of the method adopted for the presentation of the data, reference may be made to the subject of benzine, or gasoline. Four folded tables deal with various countries, the first one from Belgium to France, the next from United Kingdom to Norway, the third from Austria to Czechoslovakia, and the fourth from Hungary to the United States—all arranged in alphabetical order according to the German name of the country concerned. For each country, under a full list of tests, is given a brief description of the particular methods used, and these are supplemented by a series of some 195 notes giving the essential details of the test, together with references.

There is also a list of standard methods of test for each of the individual countries concerned, grouped under the heading "N"—Normen, or "R"—Richtlinien; the distinction between Normen and Richtlinien, at least for England and the United States, is not clear, and it might have been preferable to have grouped all official methods of testing under one heading. If the information in this table is kept in mind in using the folded tables inserted in the book, it will be seen at once which of the methods described are official, and which are taken from the literature and assumed to be used at least occasionally.

A survey of the tables shows that the methods based on those officially adopted by the D2 Committee of the American Society for Testing Materials constitute the bulk of those standardized by the various national standardization bodies.

There are a number of other methods of test, many of which are of doubtful value,

but which are quite properly included in the book as being typical of those used in various countries.

We note from the section on kerosine testing, that candle-power determinations are official in Germany, France, Italy, Russia (at least for railway purposes) and unofficial in a number of other countries, whereas in other countries the more rational methods—either smoke point and burning test, or both, have been officially adopted.

Many tests of doubtful value, including chemical composition of kerosines or bromine value, are quoted, which are unofficial in certain countries; similar so-called Raffinations-proben—sulphuric acid or alkali tests are official in Italy, Jugoslavia, Norway, Roumania and Russia, and unofficial in many other countries. Another test adopted officially in very many countries, but of doubtful value if burning tests are made, is the so-called acid content.

The chemical composition of gasolines shown as official for England applies of course only to a solvent used in asphaltene determinations, and some distinction might be adopted in future editions to indicate where the tests shown as official do not apply to the product in its principal use.

In addition, the following methods mentioned as used in Great Britain should have been omitted—S.I.T. for gasoline, compounds reacting with sulphuric acid, and S.I.T. for kerosene, and also S.I.T. and Farnborough methods for gas oils and fuel oils.

The list of tests on lubricating oils is general, and refers principally to motor oils and machine oils: turbine and cylinder oils will be considered in a future volume.

It will be noted that the list of primary products of petroleum is not complete in this volume—natural gas and asphaltic bitumens being omitted.

The compilation of this book must have taken a great deal of time and labour, as it seems to have been brought completely up to date in so far as the data from the various countries are concerned. It is announced that a translation of the book into English is in preparation, and that in the event of further editions international co-operation would be welcome.

The book is one of great value to all interested either directly or indirectly in the subject of international testing methods for petroleum. The Austrian Petroleum Institute and the Editor, Dr. Erich Molnar, have produced a book which has filled an empty space in our literature, and it is hoped that this work will be widely read, with the result that future editions will show that considerable further progress has been made towards the unification of international methods of testing petroleum.

F. H. G.

Books Received.

U.S. Geological Survey:

BULL. 880-B. RECENT MINERAL DEVELOPMENTS IN THE COPPER RIVER REGION ALASKA. F. H. Moffit. Pp. 13. 1937, Superintendent of Documents, Washington, D.C. 5 cents.

BULL. 860-C. GEOLOGY AND FUEL RESOURCES OF THE SOUTHERN PART OF THE SAN JUAN BASIN, NEW MEXICO. PART 3. THE LA VENTANA-CHACRA MESA COALFIELD. C. H. Dane. Pp. v + 86. 1936, Superintendent of Documents, Washington, D.C. 40 cents.

THE MODERN DIESEL. vi + 224 pp. Fourth Edition. 1937. Iliffe and Sons, London. 3*s.* 6*d.* net.

Since the third edition of this book was published many changes have been made in design and in ranges of diesel engines by British and foreign manufacturers. While the actual numbers of engines has increased, the tendency has been to introduce smaller rather than larger units for road transport. A separate chapter is given to the railway diesel for high-speed units of small- and medium-power types suitable for rail cars and shunting. The higher power engines for main line locomotives and fast trains are only briefly mentioned, not coming within the ambit of this book. There is also a chapter dealing with fuel injection systems, which enumerates many important new developments.

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Geology.

703. Interpretation of Grade-size Diagrams of Sandy Sediments. A. Rivière. *Compt. rend.*, 8.2.37, **204**, 441–443 and 1.3.37, **204**, 703–706.—The author states that this aspect of sedimentary petrology has been neglected and that the sieving analyses made so far have been in insufficient detail. He puts forward a new method of representing results graphically, by polar co-ordinates. Assuming Δm to be the weight of sand passing between grade sizes x_1 and x_2 ($x_1 > x_2$) and letting $x_1 - x_2 = \Delta x$, if Δm and Δx are made small by taking sufficient readings $\frac{\Delta m}{\Delta x} \to \frac{dm}{dx}$. Values of $\sqrt{\frac{dm}{dx}}$ are plotted radially (instead of $\frac{dm}{dx}$ when rectangular co-ordinates are used) and the angular co-ordinate represents x, the grade size. The advantage of plotting $\sqrt{\frac{dm}{dx}}$ is that the range of values is much less than that of $\frac{dm}{dx}$ and logarithmic co-ordinates are obviated. Thus a direct and simple interpretation of the diagram is possible.

The author states that, owing to the more detailed work, greater care is needed in manipulation than in rougher methods and the regularity of the mesh used must be checked. This method enables the environment of sediments and their lateral variation to be studied more readily than in older methods—an important aid to oilfield geology. Diagrams are given for characteristic fluviatile, æolian and marine deposits. R. O. Y.

704. Inferences about the Origin of Oil as indicated by the Composition of the Organic Constituents of Sediments. P. D. Trask. U.S. Geol. Surv., Prof. Paper. 186 H, 1937.—Petroleum is generally believed to have originated from organic matter which has accumulated in sediments. The main source of this matter is floating plant life (plankton) which serves as the chief supply of food for many types of other organisms of the sea.

The general composition of the phytoplankton (the part of the plankton consisting of plants) is discussed and also summarized in a table giving the different types of ash-free basis. This shows 24% of protein, 3% fat, and 73% carbohydrates and other non-nitrogenous compounds.

Sections follow on the composition of organic matter on a basis of ultimate analysis, the ratio of organic matter to carbon in sediments, and an interpretation of data (possible source materials).

A concluding section relates to the origin of oil itself. Bacterial activity decreases with depth of burial in sediments and a point is reached where it is relatively insignificant. Chemical and physical agencies then lead to the generation of liquid hydrocarbons, which form an oily phase insoluble in water. These hydrocarbons, after their formation, may dissolve organic materials, and the constituents of the resulting solution may subsequently react in an attempt to reach a point of equilibrium. In this way, repeated solution and consequent readjustments of the constituents would ultimately result in the formation of oil. G. S. S.

705. Means of Recognizing Source Beds. P. D. Trask and H. W. Patnode. *Calif. Oil World*, 3.12.36, **29** (20), 8 and (21), 6.—This article is a report on the results obtained from a study of eight characteristics of sediments with respect to their effectiveness as means of recognizing source-beds. The eight characteristics considered are: organic content, reducing power, colour, volatility, degree of volatility, carbon–nitrogen ratio, oxidation factor and nitrogen–reduction ratio. The relative degree of effectiveness as an index of source-beds is summarized as follows: organic content, poor; colour, poor; oxidation factor, poor; reducing power, slight; carbon–nitrogen ratio, fair; volatility, fair; degree of volatility, fairly good; nitrogen–reduction ratio, very good. W. W.

706. Porosity Factor in Petroliferous Formations. A. Rossbach. *Bol. Inform. Petroleras* (*B.A.*), Jan. 1937, **14** (149), 77–88.—Porosity, defined as the ratio of pore

volume to total volume of a piece of rock, is of chief importance in determining the capacity of a rock for storing oil. To determine the actual oil content, the percentage saturation must also be known. A method of determining porosity and saturation is described, for which accuracy and ease of operation are claimed. Porosity is calculated after determining the real and apparent densities. Granulometric analysis is of importance, particularly with reference to permeability which is a prominent factor in determining optimum well spacing. A rational scheme of exploitation also requires a knowledge of reservoir pressure and the article concludes with some reference to the origin of this pressure. The theory that it has resulted from the primary origin of the oil cannot be accepted, except for cases where the oil has been formed *in situ*. In the case of accumulation after long-distance migration, the author concludes that the pressure is hydrostatic. A. J. H.

707. On the Compressibility of Rocks. Stamatiu. *Ann. des Mines*, 1936, **19** (10), 441–445.—The author considers rocks submitted to high compression, deformation being possible only in the direction of the pressure. The laboratory experiments of Bridgman, Müller, Wöhlbier, Geller, Lehmann, Mügge and Karman are discussed and illustrated. Two factors influencing compressibility of rocks are porosity and petrographic structure, which come less into consideration in pure solids. Temperature also exerts a profound influence. Müller and Wöhlbier have studied the sediments of the German Carboniferous and Zechstein, and the results are given in the present article. The phenomena of plastic flow, on which temperature has a large effect, are discussed, together with the elasticity of rocks—that is, the behaviour of rocks when the pressure is released. In non-elastic rocks deformation takes place permanently, but in elastic types further movements will take place when the pressure is released due to the storing of energy. The paper has obvious applications to tectonics and salt-dome problems. R. O. Y.

708. Origin of the Small Sulphate Content of Oilfield Waters. T. L. Ginsburg-Karagitschewa. *Petr. Z.*, 1937, **33** (1), 7–12.—The small sulphate content and frequent occurrence of H_2S in oilfield waters were for long attributed to the reduction of sulphates by bitumen at the oil–water contact. It was later shown by Bastin that such a reaction does not take place at normal temperatures. Research has shown that bacteria which are capable of reducing sulphates with the evolution of H_2S are present in recent sediments. By enclosing two samples of naphthenic crude, one sterilized and one not, in flasks with a sulphate medium it was further shown that no reducing action took place with the sterilized oil. In the case of the non-sterilized oil, however, there was an intensive reduction of the sulphate and evolution of H_2S and also a considerable development of the micro-organism, *Microspira*. Furthermore, by sampling mud, oil and water obtained from a well drilled into a structure hitherto untapped, it was found that this organism was obtained only when the water began to appear. S. E. C.

709. Oil Wells and Microbiostratigraphy. R. Wedekind. *Petr. Z.*, 1937, **33** (1), 12–14.—An account is given of the research undertaken in Germany to determine to what extent micropalæontological methods would assist in the correlation of well samples. The results proved very satisfactory. A full-page photographic plate showing foraminifera magnified some 60–80 times is included. S. E. C.

710. Veneridæ and Petricolidæ of the Lower Austrian Miocene. F. Kautsky. *Bohrtech. Z.*, 1936, **54** (7), 157–160; **54** (8), 173–177; **54** (9), 202–205; **54** (10), 225–228; **54** (11), 250–252; 1937, **55** (1), 11–14; **55** (2), 35–40.—A biological and stratigraphical description is given of the Veneridæ and Petricolidæ of the Miocene in Lower Austria. This brings Hörnes' work in 1870 up to date. Three separate plates of photographs of these fossils are included. S. E. C.

711. Spindletop Oilfield, Jefferson County, Texas. J. B. Eby and M. T. Halbouty. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 475–490.—The Spindletop area is a dome, on the surface and flanks of which Pleistocene, Pliocene, Miocene and Oligocene beds occur.

The Pleistocene (Beaumont and Lissie formations) consists mainly of clays and sands having a maximum thickness of 1380 ft.; the Pliocene (Citronelle and Upper Fleming), shales, limestones and sandstones, 700 ft.; the Miocene (Upper Fleming) shales and sands, 3300 ft.; and the Oligocene, mainly of shales, 1350 ft.

Production comes from the Middle and Lower Miocene, and to a smaller extent from the Middle Oligocene formations. Four types of oil have been found, two in the Middle Miocene, one in the Lower Miocene, and another in the Oligocene. These types are described in detail.

The field has been a great producer, the old cap-rock area having produced approx. 50 million brls. and the new flank area 75 million brls. during 1936.

Detailed cross-sections of the Dome show the possibility of the existence of an overhang; production on the present dry flanks may, therefore, be great. G. S. S.

712. Custer Formation of Texas. R. Roth. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 421–474.—The area over which detailed mapping has been carried out covers 300 miles from Wheeler Co., Texas, southward to Coke Co., Texas. The work forms a continuation of that previously undertaken.

A number of lithological changes were observed, and these have proved of much significance in connection with the nomenclature as the beds were determined southward from Kansas to Oklahoma into Texas. The terms "Whitehouse," "Cloud Chief," and "Quartermaster" have hitherto been very loosely applied. In a similar way, also, the boundaries are very vague, *e.g.*, "Blaine of Texas" and "Whitehouse of Texas." To obviate confusion in the nomenclature and correlation of the Custer Formation, the author therefore endeavours to clarify the matter by reverting to the original definitions.

Reference is made to the alteration of anhydrite to gypsum in the sediments. Whereas the Custer shows a marked absence of any large amount of gypsum, the Blaine of Texas is characterized by the almost complete alteration of anhydrite into gypsum. Further, the anhydrites of the Custer are lithologically quite different from those which still remain in the underlying Blaine. The effect of the hydration on the beds is also discussed. In the case of the Custer the sediments consist of porous sandstones through which meteoric waters carry off the dissolved anhydrite: thus the presence of the mineral is not evident on the surface. In the Blaine, on the other hand, the enclosing beds are composed of shales which are much less pervious than the overlying sediments, resulting in massive beds of gypsum which stand out in relief.

Various topographical features are described—as, for example, Karst topography and epicycles of erosion.

A section of the paper is devoted to the unconformity at the base of the Custer. As a result of this break, two economic features occur: sub-aerial erosion has developed the commercial deposits of gypsum underlying the Custer, and has also brought about porosity in the limestones which now underlie the Custer in the Permian basin of West Texas. This porosity acts as an available reservoir for oil accumulation.

Finally, short discussions and descriptions are given of the Custer in twelve different counties. These include: Collingsworth, Hall, Stonewall, Croton Falls, Fisher and Coke. The paper contains a wealth of illustrations, no less than 15 photographs and 11 maps accompanying it. G. S. S.

713. Miocene, Pliocene, and Pleistocene Formations in Rio Grande Region, Starr and Hidalgo Counties, Texas. A. W. Weeks. *Bull. Am. Assoc. Petr. Geol.*, 1937, **21**, 491–499.—This paper is supplementary to one published in the *Association's Bulletin* for May 1933. It gives brief descriptions of the Upper Catahoula, Oakville, Upper Lagarto, Lissie, Leona, Beaumont and Reynosa Caliche deposits along the Rio Grande.

Maps are given showing the distribution of these beds, together with a N.–S. section near Starr–Hidalgo county line. G. S. S.

714. Geology and Economic Significance of Anahuac. M. T. Halbouty and J. B. Eby. *World Petr.*, 1937, **7** (4), 46–55.—This field is situated in the salt-dome region of Texas, and lies about 45 miles E. of Houston. It was discovered by geophysical methods early in 1935, and has since been proved for about 4 miles in a N.–S. direction and 3–4 miles in an E.–W.

The structure is considered to be a deep-seated salt dome with a maximum uplift of 850 ft. It is relatively circular, but broken by three complicated fault systems which run N.–S., E.–W. and N.E.–S.W. Most of the production comes from the Frio Sand of Lower Oligocene age at a depth of about 7000 ft. It is a firm, consolidated, coarse sand, and is capped by a gas horizon with a maximum thickness of 284 ft. This is overlain by sands, shales and limestones of the Middle Oligocene and Upper Miocene. The Pliocene is similarly represented, and covered by 1200 ft. of Pleistocene sands, gravels and shales. The Beaumont Clays outcrop.

Ultimate recovery is estimated at 350,000,000 brls. and is based on a figure of 600 brls. per acre foot. Production methods and costs are discussed, and several sections and maps accompany the paper. J. A. G.

715. Historical and Structural Geology of Anahuac. C. Leyendecker. *Oil Weekly*, 29.3.37, **85** (3), 30–40.—This is the geological section of a series of articles dealing with the Anahuac salt-dome field. The dome is the result of deep-seated salt intrusion, the original movement being early Oligocene, but supplemented with movements continuing to late Pleistocene. Opinions of the structural geology differ widely as to faulting, whilst some believe that erosion has taken place. Geophysical interpretations show a strong dip to the N. The upper beds lack stratification for 6000 ft., and the Discorbis horizon (Middle Oligocene) is the first to show a reflection on the seismograph, whilst the Heterostegina zone gives a perfect reflection. From the axis of the fold, which is indicated by erosional "lows" in the limestone horizons, the marine Oligocene and Frio dip S.E. on the S., N.E. on the N., S.W. on the W., and N. on the N. end. Geologists holding to erosional theories believe that the eroded axis is the evidence of ancient erosional activity on the weak part of the beds, and that the N. side of the field will close against the normal regional dip as on the W. and S. sides. A number of uplifts and depressions are referred to, as shown by the erosion of the Marginulina, Heterostegina and Discorbis zones.

The oil and gas are thought to have originated in the underlying thick series of sediments which covered a wide area, and have no genetic relationship with the salt. The salt dome has only formed the necessary structural trap for the accumulation of the oil and gas. Only bottom water is encountered, and as this moves up the structure as oil is removed a high ultimate recovery should result. The article is furnished with a number of sections, and with a table of well statistics. A. J. H.

716. Cunningham Field, Kingman and Pratt Counties, Kansas. R. B. Rutledge and H. S. Bryant. *Bull. Am. Assoc. Petr. Geol.*, 1937, **21**, 500–524.—Since the completion of the discovery well of 1931 in the Pennsylvanian Lansing Limestone, 35 Lansing oil wells have resulted, including an Ordovician and a Permian gas well.

The Ordovician gas horizons are in cherty dolomitic limestones (referred to as the "Viola Limestone"), the Upper Simpson (consisting of sands and shales), and the "Siliceous Lime," which underlies the Simpson unconformably. Oil is found below the gas in the "Siliceous Lime," and it is very probable that oil production may later be obtained from all three formations.

The Lancing (Permian) consists of limestones. Many of them are oolitic, and 110 ft. below the top of the formation is a thin oolitic bed which has produced gas.

Core-drill and subsurface structure maps of the area are given and discussed. Development and production are also reviewed, and tables of analyses of the gas from the Permian and Ordovician provided. G. S. S.

717. Late Kansas Discoveries. F. B. Taylor. *Oil Weekly*, 3.5.37, **85** (8), 74, 76, 78.—A test well which produced 35 gravity oil from the Viola lime for a short time has directed increased attention to the numerous structures existing in the Salina Basin. Other late discoveries are mentioned, one of the most interesting of which has opened a new productive zone in the Siliceous lime in Greenwood county. Active wildcatting is in progress. A. J. H.

718. 1936 Kansas Developments. G. W. Baughman and M. Lee. *Oil Weekly*, 3.5.37, **85** (8), 67, 70–72.—This article describes exploitation work resulting in the discovery of 54 new fields during 1936. Most of the discoveries were located on the Central

Kansas uplift, whilst Clark County has seen much activity following the discovery of production from the Viola limestone on the N. flank of the Anadarko Basin. Producing horizons in the new fields range in age from basal Cambro-Ordovician to lower Permian, the Arbuckle dolomite being the pay horizon of more than half of the discoveries. A. J. H.

719. Important Exploratory Well is Started Near Syracuse, Kas. E. Bloesch. *Oil & Gas J.*, 6.5.37, **35** (51), 39.—The Syracuse structure in Western Kansas was originally mapped in 1876, and the first test well drilled in 1924. No commercial production was obtained, although several oil and gas shows were encountered. The well was abandoned at 5488 ft. in what is thought to be the Chester formation. The structure is located on a large anticline which plunges eastwards; recent mapping indicates the presence of a number of domes on this uplift. A seismograph survey proved folding in the underlying Palæozoic and it is expected that the folding will have affected the deeper formations to a greater extent than those near the surface. The Dakota Sandstone (Cretaceous) outcrops and rests unconformably on the Carboniferous. The Simpson formation (Ordovician) is the main objective of the test, but several horizons may prove to contain oil. J. A. G.

720. Crude Oil Reserves of Western Kansas. M. Lee. *Oil Weekly*. 3.5.37, **85** (8), 48–49.—Estimates of reserves are handicapped by the incomplete development of many fields and by production under proration. Estimates in this article are limited to known producing formations, of which lime formations of Pennsylvania, Mississippi and Ordovician ages are the most important, being credited with more than half of the oil to be produced. A conservative estimate of 273 million brls. is given for W. Kansas reserves, but this should be increased by new oilfields discovered by current drilling. A. J. H.

721. Oil Prospects along the West Flank of Turner Valley Gasfield. J. G. Spratt and V. Taylor. *Petr. Times*, 24.4.37, **37** (954), 537–541.—In the past, Turner Valley has been famous for its high gravity naphtha obtained from large quantities of natural gas produced from a dolomitic limestone of Carboniferous age. The amount of gas produced per unit pressure drop has increased in the last few years, whilst wells down the flank have changed progressively from naphtha to a crude oil. It is believed that with the depletion of gas from the top of the structure, oil is migrating up the W. flank, probably backed up by a water-drive. Water encountered in the structure shows an increasing chloride concentration to the W. and an increasing similarity to that found in the Highwood structure 3 miles W. of Turner Valley; this is taken as further evidence of a water-drive.

In June 1936 the deepest well on the W. flank was brought in at 850 brl. per day, with 2000 million cu. ft. of gas, and the production has been well maintained. The reservoir capacity in the oil area is believed to be about 100,000 brl. per acre, but the high shrinkage factor makes the possible average oil reserve 50,000 brl. per acre. The oil area is ill-defined, but probably covers about 5000 acres. The area appears to be of major importance, but much will depend on the results of further drilling and on the adoption of a rational exploitation scheme. A. J. H.

722. Greater Possibilities in Dickinson. F. L. Singleton. *Oil & Gas J.*, 13.5.37, **35** (52), 102.—This structure, in Galveston Co., Texas, is about 3 miles long and from 1 to 2½ miles wide. Production is from four horizons in the Frio at depths ranging from 8400 to 9100 ft. The field is divided into three areas by faulting—the Dickinson, Way and Gillock. Insufficient evidence is available to determine whether these areas are connected or not. The producing section is from 20 to 50 ft. in thickness and is composed of sand and sandy shales. Additional wells are being drilled to test the areas near the fault planes. J. A. G.

723. Hugoton Gas Area. F. B. Taylor. *Oil Weekly*, 3.5.37, **85** (8), 56–64.—The discovery well was drilled in 1920 as an oil test and found gas in a broken lime formation, but no development took place until another well produced gas six years later. The

structure is a monocline, production coming from the Herington lime, the Winfield group and the Fort Riley limestone, all in the Big Blue series of Permian age. The general trend of the productive beds is slightly E. of N. The productive strata are very irregular, and there is some evidence of interconnection. The productive area extends well into Oklahoma, and certain peculiarities, notably similarly subnormal original rock pressures, suggest connection with the Texas Panhandle gas area. To date there are no indications of oil on the monocline which seems to be devoid of all accumulative folds. Calculations give the reserves of the Kansas portion of the field as 15,736 million cu. ft. An analysis of the gas which yields about 4·2 gallons of gasoline per 1000 cu. ft. is given, and drilling and completion practices are described. A. J. H.

724. Possibility of Future Oil Production in Michigan. V. R. D. Kirkham. *Oil & Gas J.*, 13.5.37, **35** (52), 45–46.—Under a glacial cover the Michigan Basin represents a depressed region filled with Palæozoic and older sediments. The author believes that the downwarping was due to the movement and withdrawal of large masses of magma, and the subsequent deposition of sediments in the basin formed a load which aided the downward movement. The pre-Cambrian has been depressed to depths varying from 1200 to 1500 ft. The joints and faults present in this series became the chief lines of weakness which subsequently developed into a series of step-faults. As sedimentation progressed, movements occurred along these lines of weakness and developed folding which eventually changed to faulting in the deeper formations.

In the opinion of the author, a subsiding basin which provides relatively stagnant and shallow conditions offers the best environment for the concentration of oil-forming organic material, but the accumulation of the oil depends on the presence of a suitable porous formation in the invaded land surface. Central Michigan has been subsiding since early Palæozoic times, and has been continuously covered and uncovered by the sea. It is expected that not only the Traverse and Dundee horizons will contain commercial pools, but also many of the deeper formations.

Two faults cut across the general N.W.–S.E. folding and form a graben which drags the folds to the N. on the graben sector and to the south on the adjoining areas. Most of the oil has so far been produced from the graben sector, and it is expected that many of the future discoveries will be located here. J. A. G.

725. Geology of the Carbonaceous Deposits of Coro, State of Falcon. C. Wiedenmayer. *Bol. Geol. y Min.*, Jan. 1937, **1** (1), 65–81.—Coro, the capital of Falcon, is situated on a coastal plain consisting of alluvial deposits, mainly clays and coarse sands of no great thickness. The geological province is characterized by considerable variation in the nature of the sediments, indicating radical changes in the conditions of sedimentation, and though coal was only formed in estuaries and stagnant lakes, the seams show considerable lateral variation in quality and thickness.

The carbonaceous basins of Mina de Coro and El Isiro are described, and show marked similarity. In each area the beds have been folded into an anticline, and later broken by a thrust to the N. resulting in a true overthrust. The S. flank of each anticline dips gently, but the N. flank is faulted, steeply dipping, and even overturned, while in the case of El Isiro it has almost completely disappeared. Both thrusts start on the W. in a series of transverse faults, and die out to the E.

There is a gradual transition from the Valle or Querales series to the carbonaceous El Isiro series. The latter was deposited in shallow water, and almost all the horizons are carbonaceous. There are two main coal seams in each area, and the upper ones, which are the more important, underlie sandstone beds which constitute good "marker" horizons. In the Mina de Coro area the sandstone is separated from the upper seam by about 8 m. of gypsiferous clays. The sandstones usually contain water under low hydrostatic pressure, but there are possibilities of natural gas, particularly E. of San Antonio, where there is a small dome. The carbonaceous series at El Isiro is similar, though thicker, and the sands and coal seams are distributed differently.

Recommendations are made for the further study of the deposits, and a number of maps and sections and a stratigraphical table accompany the article. A. J. H.

726. Structure of Tertiary Strata in Bavaria. H. Andrée. *Oel und Kohle*, 1937, **13**, 151–153.—A bore-hole (1426·6 metres) at Taufkirchen, core-drilled in part, has yielded

the first certain knowledge of tertiary formations in this region. Petrographical analyses of the strata are given for the various levels. P. G. H.

727. Esthonian Natural Gas Occurrences. D. W. Bartels. *Petr. Z.*, 1937, **33** (1), 1–7.—Gas occurrences have long been known in Kokakär island and in small and great Wrangelsholm, considerable quantities having been obtained from water wells. Gas has also been obtained from water wells on the mainland, near Reval, and occurrences are common along the foot of the Klint. The question of the origin of this gas is critically examined. Comparison of the properties of the natural gas with those of gas obtained by distillation of the Dictyonema shales shows them to be dissimilar. It is suggested that it had its source in Cambrian rocks, and in such a case large quantities under considerable pressure may be expected. The helium content is of interest, and in this respect it may be noted that natural gas from the island of Öland, off the E. coast of Sweden, has a helium content of 1·4%. The Esthonian natural gas is dry, and there is as yet no evidence that it is associated with petroleum. S. E. C.

728. Bucsani Field, Roumania. V. Zatinca. *Ann. des Mines*, 1937, **20** (2), 51–53 and (3) 89–91.—Early prospecting took place in this region from 1900 to 1908, but it was not until 1932–33 that geophysical studies revealed the general form and axial trend of the fold. Owing to the intense folding, the structure can be determined only with difficulty, despite 70 wells drilled and 20 drilling. The field is on an anticline the axis of which is S.W.–N.E. On the crest at Magura Bucsani the salt has reached only the Meotic, but a series of fractures contemporaneous with the salt intrusion gives rise to different conditions in different areas. The N. flank is gently dipping, but the S. flank steep, particularly near Magura Bucsani, when it is associated with faulting.

Production is from the Meotic, which contains three zones, the deepest of which is most consistent. Initial casing pressures are 100–130 atm. in the S. and 135–150 in the N. Bottom hole pressures were 160–180 atm. in the first wells giving 300 tonnes/day. Very keen competition in the S. and E. led to ruinous gas/oil ratios of more than 1000 m.³/ton. The oil is a light paraffinous crude from 0·08 to 0·874 in gravity. Gasoline extraction is adopted and the high-pressure gas is used for lifting at Gura Ocnitzei and Lazvad. Various attempts at proration have been made, and these are described in detail. The account is illustrated with a structural map of the field, and numerous references are made to well records. R. O. Y.

729. Structure of Transylvanian Gasfields. D. Ciupazea. *Ann. des Mines*, 1937, **20** (3), 105–106.—The reference gives a summary of a paper read at the Paris International Congress of Mining, Metallurgy and Applied Geology. The gas pools of the region are divided into four groups: (*a*) Central group of gentle domes. A Pliocene cover of 50 m. serves to protect the gas horizon. The crests of the domes are only 300 m. higher than the synclines. (*b*) The S.W. group, occurring on a broad arch surrounded by an extensive syncline. The area covers 700 sq. km. (*c*) S.E. group, comprising the brachyanticlines Dacia and Cristur, and the dome Brunesti-Crit. The area is bounded on the N. and E. by a syncline in Pliocene, and drilling has not been conclusive in this region. (*d*) The N.W. group includes the dome Sarmasel and the brachyanticlines Sineai and Zaul. The region is bounded on the south by a syncline. The domes here occur about 1000 m. higher than in the centre of the basin. No. 2. Sarmasel from 1908 has given 2×10^9 m.³/cm. of gas. The initial pressure of 35 atm. has declined to 15 atm. It would seem that very few of the domes in Transylvania have been exploited up to the present. R. O. Y.

Geophysics.

730. Geo-Electrical Measurements in Drill-Holes. S. H. Shaw. *Mining Magazine*, April 1937, **56** (4), 201–208.—Amplifies the description of electrical logging published in the January issue of the *Mining Magazine*. Resistivity and natural potential curves are plotted for a series of drill-holes in formations ranging downwards from Cretaceous to Silurian in Britain. Schlumberger's assertion that logging can only be made in uncased holes is refuted by satisfactory resistivity measurements in relatively

shallow cased holes. It is pointed out, however, that such records may be impossible in deep or crooked borings. Variation in the natural potential curves are ascribed to electrochemical and electrofiltration effects. D. W.

731. Observed and Calculated Values of the Magnetic Intensity over a Major Geologic Structure. L. F. Uhrig and S. Shafer. *Beitr. zur Geophysik*, 1937, **49** (1/2), 129–139.—A cross-section was drawn across the Los Angeles Basin from Azusa in the N.E. to the San Pedro Hills in the S.W. The geological details for this section were obtained from oil-well data, seismic and gravity surveys, and geological mapping. Values for the horizontal and vertical components of the magnetic field along this profile were calculated, the boundary between the granite and overlying rocks being assumed to be smooth. The problem was further simplified by reducing it to the consideration of two semi-infinite blocks of different magnetic permeabilities separated by a sinusoidal boundary and placed in an inclined field.

Field measurements were made with Askania magnetometers, the vertical component of the magnetic field being measured at intervals of $\frac{1}{4}$ to $\frac{1}{2}$ mile, and the horizontal component at intervals of 3 to 4 miles. Comparison of the observed and the calculated values showed that good agreement was obtained except in the vicinity of the San Pedro Hills. There the calculated values of the vertical and horizontal components were too high by 200 gamma and 600 gamma, respectively. This error could be eliminated by assuming a greater thickness of metamorphics and sedimentaries in the San Pedro Hills section. S. E. C.

732. Best Methods of Finding Oil. Anon. *Rev. Petr.*, 23.4.37, (732), 539.—Notes are given on the A.A.P.G. meeting at Los Angeles, March 1937, when the maintenance of oil reserves was discussed. During 1936 geophysics had been successful in the San Joaquin valley and Rocky Mountain region. Of the oil discovered recently by the following methods: (*a*) wildcat wells, (*b*) surface indications, (*c*) geological sites for wells, (*d*) geophysical sites, figures show that geological and geophysical methods are preferable and dry holes considerably reduced by these methods. Geophysics is expected to play the major part in the attempt that is to be made to maintain oil reserves at their present level. R. O. Y.

733. Geological Complex of Iowa is Problem for Geophysicist. W. G. Osborn. *Oil & Gas J.*, 13.5.37, **35** (52), 51–52.—The thick glacial deposits which cover most of Iowa mask the geology of the underlying formations, but sufficient water-wells have been drilled to enable the main structures to be outlined. Four major uplifts affect this region: The Winconsin in the E. and N.E., the Dakota in the N.W., the N.E. Missouri Uplift in the S., and the Nemaha Ridge in the extreme S.W. The Wilson–Thurman fault separates the Dakota Uplift from the uplift of N.E. Missouri, and the McPaul fault, which runs at right angles to the Wilson–Thurman, separates the Nemaha and Dakota Uplifts. It is considered probable that these two movements are the main features of a series of faults on the Dakota Uplift. The Winconsin Uplift is probably affected by doming associated with pre-Cambrian intrusions, and these features seem to be the most promising structures for oil accumulation.

The maximum thicknesses of the formations in this region are as follows: Cretaceous 250 ft., Pennsylvanian 1900 ft., Mississippian 500 ft., Devonian 250 ft., Silurian 600 ft. and Ordovician 1000 ft. Almost every type of structure favourable to oil accumulation is present in the State and geophysical work should assist in locating many of them. J. A. G.

734. Practical Graphical and Approximation Methods for Dip Shooting Calculations. S. J. Pirson. *Oil Weekly*, 26.4.37, **85** (7), 22.—Dip reflection shooting consists in obtaining records showing unidentified reflections, from the configurations of which the dip of the subsurface formations can be computed. If the beds pinch out, but their interval remains constant, the dips permit a subsurface contour map to be drawn on a phantom horizon.

The reflected waves are picked up at the surface by a series of detectors along a line passing through the shot point. The dip of the beds affects the differences in travel

time for the reflected waves to the first and last detectors, and dips can be calculated from these differences. In a graphical method the elastic image of the shot point is constructed, but nomographic methods are quicker and more dependable, although the charts are not universal.

The field procedure in straight dip shooting involves making long closed profiles. A series of phantom horizons is drawn at different depths, and closure errors are usually evenly distributed over the points. Certain simple approximate formulæ permit the calculation of dips for any given spread and distance between the extreme geophones. A further approximate equation is suitable for use in virgin territory where the overall velocity is unknown, provided shots are made in opposite directions from points symmetrically placed with respect to the centre of the spread.

When subsurface dips are considerable it is necessary to allow for side swipe, *i.e.*, to compute the depth and location of the reflecting points as well as the dips. This can be achieved by shooting in three directions (preferably at right angles), assuming that correlation between the three records is possible. The image of the shot point is given by the intersection of three spheres centred on the centres of the three spreads, and of radii equal to the product of the appropriate times and velocities.

In continuous profiling dips can be obtained by continuous development of the geophones in straight or curved lines along the surface of the ground, with one or two reflection points overlapping on each spread. The method gives excellent results, but is slow, and at present is used only on very complicated structures or where detail is required. G. D. H.

735. Electrical Coring Practices on Gulf Coast. L. W. Storm. *Oil & Gas J.*, 15.4.37, **35** (48), 145.—Electrical surveys have two main uses which apply especially in the Gulf Coast region: (1) to provide a log of the formations and (2) to distinguish the fluids in them.

The first use has been described fully many times. In this area the stratigraphy is a monotonous repetition of similar sands, and they differ so little lithologically that driller's logs are practically useless for geological correlation. Electrical logging reveals by corresponding peaks and depressions in the porosity and resistivity logs the recurring changes from sand to pure shale through every variation of sandy shale and shaley sand.

A comparison of the porosity and resistivity logs, either by themselves or in combination with core information, will distinguish an oil or gas sand from a salt-water sand in probably 95% of the cases. L. V. W. C.

736. Thyssen Gravimeter. Anon. *Petr. Z.*, 1936, **32** (44), 18–20.—The Thyssen gravimeter was designed to replace the costly and slow pendulum method of measuring gravity variations. Measurements were originally confined to regional gravity anomalies over great areas, but with improvements in the sensitivity of the apparatus small anomalies can now be investigated. It can be used in areas where the topography precludes the use of the torsion balance. More than 10 stations per day have been measured in the U.S.A., with an average error of not more than $\pm$ 0·25 milligal. S. E. C.

737. New "Emanations-balance." W. O. E. Scheuer. *Petr. Z.*, 1937, **33** (5), 9–10.—The absorption of radioactive rays in the uppermost strata of the earth's crust is so great that direct measurements of their intensity were possible only when their source was very shallow. The author has now designed and built a highly sensitive balance system by means of which the intensity of the gamma radiation may be measured.

A brief description and a photograph of this instrument are given. S. E. C.

Drilling.

738. Advancement in Drilling Equipment and Methods. H. L. Edwards. *Oil & Gas J.*, 15.4.37, **35** (48), 137.—Many improvements have been made in drilling equipment and methods and more progress has probably been made in the construction of draw-works than in any other line of equipment. Unitized draw-works of the three-shaft,

four- and six-speed type with hydromatic brake to help hold the heavy loads are available and boilers with no rivets and some with no domes can also be obtained.

The friction of mud through the mud lines and drill-pipe to the bit has been reduced by the use of improved hose and wash-pipe as well as by improved tool joints.

L. V. W. C.

739. Engine-Electric Drilling Methods. B. H. Berkeley. *Petr. World*, 1936, **33**, 281–283.—Describes the features of direct-current diesel electric drilling rigs, sizes and speeds of engines, generators and motors, drive arrangement, enclosed cooling-water system, control gear and combined operating characteristics to provide a balanced rig which is easily manipulated, easy to maintain and give flexible and efficient transmission between engines and the various power driven elements of the rig.

W. W.

740. Improvements Required in Rotary Drilling Equipment. J. E. Brantly. *World Petr.*, 1937, **8**, 62–66.—Modern rotary drilling equipment and procedure are criticized, the writer pointing out that since this form of boring came into general use in the oil industry 35 years ago, there has been very little change in the design of the equipment employed. There is room for improvement, and some suggestions in this respect are offered.

W. W.

741. Development Practice in the Sulphur Bluff Field. J. A. Kornfeld. *Petr. Eng.*, March 1937, **8** (6), 44.—The Sulphur Bluff field of Texas provides difficulties in the drilling of vertical holes on account of a major fault, and completion difficulties resulting from low-formation pressures. All wells so far drilled have been flowing oil wells and no dry holes have to be recorded.

The wells are about 4500 ft. deep and two casing strings and a 2½-in. tubing string are run. Acid bottle is run every 250 ft. and a maximum deviation of 5° from vertical is required of the drilling contractor.

Drilling time is 13 days and the average cost for a completed well is $20,000.

L. V. W. C.

742. Salt Water Used as a Drilling Fluid to Prevent Blow-outs. T. P. Sanders. *Oil & Gas J.*, 18.3.37, **35** (44), 50.—In the New Mexico and West Texas fields salt water has often been used as drilling fluid. It has been found that brine has sufficient weight to prevent blow-outs, and it has the advantage that gas will bubble up through it to the surface. A considerable saving in the purchase of mud is shown by this practice.

L. V. W. C.

743. Deep Wells to be Drilled to Secure Subsurface Data. L. G. E. Bignell. *Oil & Gas J.*, 11.3.37, **35** (43), 46.—The decrease in the rate of finding oil may result in the co-ordination of the two main branches of the science of prospecting combined with drilling "exploratory" wells.

Only modern equipment and methods will be used in drilling these test wells and a description of the mechanical details of drilling is given.

L. V. W. C.

744. Offshore Drilling Presents Problems. J. D. Hughes. *Oil & Gas J.*, 15.4.37, **35** (48), 163.—The construction and deflecting costs of directional drilling are considered, and the conclusion is reached that directional drilling methods may be used at a great saving and added convenience over conventional drilling methods ashore.

L. V. W. C.

745. Acid Successfully Loosens Stuck Drill Pipe. J. G. Staudt. *Oil Weekly*, 12.4.37, **85** (5), 30.—The sticking of drill pipe in a hole may result from a number of factors. The pipe may be stuck in withdrawing it from the well due to a boulder that may have fallen in or to cuttings that have settled out. In other cases the formation may have squeezed or the pipe may have twisted off.

Acid may be used to loosen stuck drill pipe to eat up the obstruction or enough of the formation to loosen the pipe.

A description of the method of inserting the acid is given.

L. V. W. C.

746. Efficient Practices Cut Well Costs at Anahuac. N. Williams. *Oil & Gas J.*, 1.4.37, **35** (46), 28.—The development programme in the Anahuac field, Texas Gulf Coast, has been expedited through substantial reductions made in the drilling and completing times.

The well time in the field has been lowered to such a point that with four rigs working, from five to seven wells are being completed to about 7000 ft. monthly. The fastest time for a well has been 14 days with an average time of 17 days.

L. V. W. C.

747. Progress in Metals. W. L. Nelson. *Oil & Gas J.*, 22.4.37, **35** (49), 69.—The low silicon cast irons are scarcely more expensive than ordinary cast iron and their physical properties are superior in nearly all respects. One of the best known is Meehanite Metal, which contains 0·75/1·4% silicon and 1% of some other alloy element usually Mn or Cr. It is used extensively in the refining industry for tube-supports in pipe stills, also for bubble caps and trays, baffles in fractionating towers. Tests showing the superior heat-resisting properties of HB Grade Meehanite are described and illustrated. Advantages of the metal are :—

(1) Resistance to scaling, distortion or growth at elevated temperatures.
(2) Resistance to mild abrasive conditions such as that caused by the velocity of hot oils and vapours.
(3) Mild resistance to sulphur corrosion.

A summary of the conclusions reported in Research paper R.P. 945 of the Bureau of Standards regarding soil corrosion of non-ferrous metals is given. The use of molybdenum steels for the exceptionally hard service encountered in the obtaining of oil-well cores from hard formations is described. R. A. E.

748. Fifth Report of the Wire Ropes Research Committee. W. A. Scoble. *Proc. I. Mech. E.*, 1935, **130**, 373–449.—The present Report, like those which have preceded it, includes results which can be divided into two sections. The work of the first section follows from data recorded in earlier Reports. The Fourth Report included test results for ropes of 2 in. circumference which were tested on the larger machines, whilst the facilities for handling larger ropes allowed those consisting of more wires to be tested, since these more flexible constructions are not generally made of 1-in. circumference. Rope 20 of 2 in. circumference, 6 × 19, was included for comparison with the earlier 1-in. ropes of similar construction to indicate the importance or otherwise of the scale effect. The 2-in. rope was somewhat inferior to the poorer of two 6 × 19 1-in. ropes, Nos. 10 and 14, which differed appreciably in performance. Comparison of two 6 × 19 Trulay ropes, one about three times as large as the other, confirmed the superior life of a small compared with a large rope under corresponding conditions. Nos. 10 and 14 showed that appreciable differences may be met with in ropes supposed to be similar, so that it was thought that the apparent inferiority of the larger rope was partly due to the fact that No. 20 belonged to the lower region of the range of performance which may be anticipated. Another 6 × 19 rope of 2 in. circumference, No. 26, of the same tensile strength as No. 20, was available, so it was tested to check this supposition and the probable range of behaviour.

A few further tests of the 2-in. circumference ropes, arranged 6 × 19, 6 × 24, and 6 × 37, were made under more severe conditions than were covered by the data of the Fourth Report. The investigation of the effect of rope speed was carried a stage farther by an attempt to discover whether slip between rope and pulley was a possible cause of a reduction of rope life at higher speeds. The lubrication of ropes has been the subject of more detailed study and an Appendix by Mr. P. G. Taigel, B.Sc. (Eng.), G.I.Mech.E., is included giving the results of many experiments and throwing further light on this important matter.

The second section of the Report records the results of new work which, although it is necessarily related to, is not merely an extension of, the earlier experiments. Three flattened-strand ropes of different but typical constructions were fully tested over pulleys. A set of ropes made from the same wire, but in 6 × 7, 6 × 19, 6 × 24, and 6 × 37 constructions, was tested to confirm whether the pulley diameter should be related to the wire or to the rope diameter. Of another set of three ropes of similar

construction and size, two were of wire having tensile strengths of 80–90 and 100–110 tons/sq. in., respectively, obtained by drawing, and the third was of wire of 80–90 tons/sq. in. tensile strength, secured by heat treatment, to confirm the effect of the tensile strength of the wire on the life of ropes and to determine whether heat-treated wire was as good as drawn wire. These ropes were made under the supervision of Mr. A. T. Adam, of Messrs. Bruntons, and were prepared for tests in connection with his questions in the Discussion on the last Report.

Experiments were carried out on a new machine designed to represent ropeway conditions. A rope under tension was traversed by a pulley taking a lateral load, which caused the rope to bend through a small angle at the pulley. Comparative tests of ropes on chilled and ordinary cast-iron pulleys were followed by similar tests on pulleys made of other metals or with linings at the tread. In most of the constructions dealt with, ropes were examined under an empirical static bending test and the measurements made were plotted and analysed. Little is said about the wire itself, because, although more time and work have been devoted to it than to the complete ropes, many results have been negative, whilst experience has shown that hasty conclusions are likely to be wrong. It is considered that the new tests developed during this research should be given further trial before they are recommended for general use.

This being the final Report of the Committee, the opportunity is taken to review the conclusions which have been reached from time to time, and an attempt is made to stress the practical bearing of some of them. W. W.

Production.

749. Producing High Distillate Wells. F. Love. *Oil & Gas J.*, 15.4.37, **35** (48), 140.—Several problems and hazards arise when producing high-pressure distillate wells. Among the more serious are sand cutting resulting in bringing wells in too fast and the freezing action occasioned by reduction of pressures.

Sand cutting can be minimized provided the correct mesh screen is set in the hole and the cement job is properly done and the freezing action of a high-pressure distillate gas well can be combatted by the use of effective pressure-reducing systems. These systems provide for one or more pressure reducing regulators, of the same choke type, in the line from the well to the separator. Each makes use of a hot-water heater to protect the system from freezing through the last pressure reducing stage. L. V. W. C.

750. Apparatus for Simultaneous Checking of Bottom-hole Pressure Bombs. A. S. Parks. *Petr. Eng.*, March 1937, **8** (6), 54).—Accurate bottom-hole pressure recording is imperative in those fields where proration is based on such pressure, and calibration of the instruments is therefore important.

An apparatus has therefore been designed to ensure that all instruments used in making a survey are registering alike. This apparatus consists of a short piece of 7-in. casing, fitted with legs and end-cap, so as to stand upright. All the instruments to be calibrated are suspended inside the casing. The pipe is filled with water heated to bottom-hole temperature, the instruments are all loaded and put in the bath, the top is put on the container and pressure applied to the entire system with a dead-weight tester. The pressure is held constant for short periods at various levels, and from the data obtained complete calibration curves are plotted for all clock equipped instruments. L. V. W. C.

751. Separation and Disposal of Salt Water in Michigan Fields. J. C. Albright. *Petr. Eng.*, March, 1937, **8** (6), 47.—The use of wooden tankage for the separation of oil and water by heat has resulted in a reduction in the amount of fuel required. All the salt water produced is disposed of underground in a stratum of glacial drift. L. V. W. C.

752. Use of Density Factor in Predicting New Oil Reserves. D. Hager. *Oil Weekly*, 26.4.37, **85** (7), 16–18.—Calculations of reserves are made using as a basis the "density factor," which is the ratio of producing acreage to the total producing acreage plus prospective acreage. This method of calculation raises estimates of future recovery in the U.S.A. to just short of 50,000 million brls. A. J. H.

753. Theory of Oil and Gas Accumulation by Retreat and Advance of the Salt-Water Table. J. H. Gardner. *Oil Weekly*, 12.4.37, **85** (5), 18–19.—After stating his objections to the anticlinal theory of oil accumulation, the author bases a new theory on the fact that salt water will prevent oil and gas from rising to the surface. It is suggested that movements of uplift or depression produce corresponding retreats and advances of the salt-water table which will drive oil and gas into existing structural traps. The theory is applied to fields in the E. Texas embayment, where uplift at the end of Eagle Ford time drained the Woodbine sand of its salt-water content. Subsequent depression before the deposition of the Austin chalk allowed the salt water to readvance, driving oil and gas before it into the sand. Oil not trapped would either escape at outcrop, or a long strip of oil accumulation would result where the water table had a top limit or a wide regional overlap crossed the sand. A. J. H.

754. Conditional Mud used to Kill Wild Well in Wyoming. L. G. E. Bignell. *Oil & Gas J.*, 18.3.37, **35** (44), 59.—A big gasser in N. Wyoming was brought under control on February 28, after flowing wild since January 19, 1936.

Water was originally pumped into the formation through an adjacent well, but without success. Another relief well was then drilled about 190 ft. away from the wild well and after water had been tried it was decided to attempt to mud off the gas sand. For this a conditioned mud was used successfully. L. V. W. C.

755. Nowater Flood Project. Anon. *Nat. Petr. News*, 2.12.36, **28** (49), 77.—Results are presented of the Forest Producing Company's first water-flooding project in the Nowater district of Oklahoma. Work was begun in July 1935. By the end of October 1936 the operations had resulted in a recovery of 523,873 brls. From the aspect of water-flooding the peak of oil production at Nowater has been passed, and the operations will now yield less output. Some data on the cost of the flooding work are given. W. W.

756. Oil in the Dominions. Anon. *Rev. Petr.*, 2.4.37 (729), 430–431.—Notes from "Records of Geol. Survey of India" by Dr. A. M. Heron. In Burma, Yenangyaung is still extending on the E. flank, and the S. part is at present giving the main production. At Singu, new horizons have been discovered in the S., and this field is run on modern and prudent lines as regards gas conservation. Yenangyat, Padaukpin and Yenanma have increased in production.

In Assam, Digboi has maintained its level, whilst difficulty in drilling and high gas pressures have held back Masimpin.

In the Punjab new deeper horizons have been discovered at Khaur and Dhulian, but production from these is poor. R. O. Y.

757. Gas-Lifting Methods. M. Tucker. *Oil & Gas J.*, 25.3.37, **35** (45), 58.—Detailed study of tapered tubing strings has been of great importance to gas lift, resulting in the working out of the basic idea of the modern flow valve. These valves are precision devices for the most part controlled by differentials in pressure between the casing and the tubing. Bottom-hole intermitting devices controlled by fluid level, and not by time, are the latest developments in gas lift for such fields as E. Texas and the stripper fields.

The use of gas lift is increasing in the E. Texas field, and a series of experiments is being carried out to determine at what pressure flow will stop and other flow characteristics. The quantity of gas required to lift a barrel of oil in this field is about 220 cub. ft. per 1000 ft. of lift under good flowing conditions, but when water makes its appearance a different set of conditions must be dealt with and about 30% more gas is required than for oil.

The demand for casinghead gas products has proved of importance to the gas lift operator in E. Texas and the fact that the demand is growing will ensure greater interest in gas-lift operations. L. V. W. C.

758. Effect of Corrosion on Production Equipment. W. St. M. E. Crake. *Petr. World*, 1936, **33**, 305–308.—A brief synopsis covering oilfield corrosion presented in four main sections :—

(1) Theory of Corrosion. Describes in an abbreviated manner the accepted facts relative to corrosion in the light of the electrochemical theory.

(2) Field Corrosion. Deals with the preliminary information required on entering a new field in order to make decisions as to the class of equipment to be used and the methods of installation with reduction of corrosion as the focal point.

(3) Protective Coatings. Presents some remarks and data with respect to various types of protective coatings usable in the field and their suitability relative to the theory of corrosion.

(4) Protection of Field Equipment. Gives various suggestions and recommendations for the protection of tankage, derricks, substructures, buildings, casing, tubing, sucker rods and pipe-lines for various field services. W. W.

Transport and Storage.

759. New Pumping Station at Ploesti–Telejean for the Transference of Lamp Oil between Baicoi and Constantza. S. Darmanescu. *Mon. Petr. Roum.*, 1937, **38**, 315–321, 401–410, 615–627.—The old station at Ploesti Vest was incapable of coping with the increasing export of lamp oil from Constantza. The article is a very complete account of the planning, construction and operation of the new station at Telejean, which came into operation in 1934, and which in early 1936 handled 66·6% of the lamp oil pumped by the Baicoi, Ploesti Vest and Telejean stations. The future possibility of handling petroleum spirit has been given due attention.

Numerous tables are given showing the factors which affect the station, such as Roumanian production and export of lamp oil, the quantities and types of oil handled, the production of different companies using the station, operating data, etc.

The storage capacity of the station at present is 20,000 tonnes, and its daily output 2700 tonnes. The maximum daily capacity of lines supplying the station is 5400 tonnes. The pumping system is based on two completely independent units, one being an electric centrifugal pump and the other diesel-powered piston pumps.

The article is freely illustrated with plans and photographs of the station.

T. C. G. T.

760. Effect of Paint Colours on Evaporation Losses. J. C. Albright. *Nat. Petr. News*, 14.4.37, **29** (15), 63).—The determination of under-roof temperatures and actual measurements of losses indicates that the lighter the paint with which a tank is treated, the lower is the loss by evaporation. A series of containers painted with various paints and exposed for 15 minutes to a carbon arc showed that with aluminium paint the temperature rise was 20·5° F. and with black enamel 54° F. Observations made on large tanks indicated that white paint was more efficient but less durable than aluminium paint. Highly reflective paints are efficient only while they remain clean, and from this point of view white paints that tend to "chalk" retain their efficiency longer than others from which the deposited dirt is not partly removed by the "chalking" process. The erection of an insulated housing over a tank is efficient is reducing both the deposition of dirt and the tank temperature. H. G.

761. Corrosion in Salt-Water Disposal Lines Obviated by Asbestos-Cement Pipe. L. H. Towers. *Petr. Eng.*, April 1937, **8** (7), 51.—In the last few years 125 miles of asbestos cement lines have been installed in salt-water disposal systems in Kansas and Oklahoma, and to a smaller extent in Texas and other areas. They have also been used as lead lines for corrosive crudes, fresh-water supply lines to camps, etc., low-pressure acid lines and as smoke-stacks. The pipe is made up from 85% Portland cement and 15% asbestos by weight (50% by vol.) on a rotating mandrel, under a pressure of 2000 lb. per sq. in., being cured by a special process. All sizes of pipe are available, whilst the strength of the pipe increases with age. The joints are equipped with asbestos cement couplings and two rubber rings, over which the coupling is forced. The flexibility of the point allows for contraction and extension and settling, and takes up vibrations. The rubber used does not deteriorate in salt water, although the effects of oil are not definitely known, whilst no deposits are formed in the pipe. C. L. G.

762. Special Cathodic Protection Unit to Overcome an Unusual Electrolytic Condition. D. Harrell. *Petr. Eng.*, March 1937, **8** (6), 50.—A 12¾-in. enamel coated pipe-line laid on piling in loose sandy soil into which drained weak sulphurous acid from a sulphur company's works has been protected from corrosion by a cathodic unit. At first a small wind generator with a capacity of 120 watts was installed, maintaining a negative potential of 0·3 volt on the pipe; but after 18 months the long sleeve on the piling had become metal bound, allowing the mile of coated section to connect electrically with 1200 ft. of 16-in. line on which there was scarcely any coating, thus throwing too heavy a load on the generator and allowing the potential to become positive. The entire section was then protected by using a piece of junk 8-in. pipe as an anode and applying a current of 35 amps. at 22 volts generated by a gas engine. After a month's experience it was found possible to reduce the current to 25 amps. at 23 volts and still give complete protection. The unit was used to determine the amount of chemical action produced by unit current in unit time in a solution of salts as exists in the drain ditch. It was found that 1 amp. removes 14 lb. of junk metal per annum. The unit consumes 600 cub. ft. of gas per 24 hrs. on full load and oil at the rate of one quart a week. Only minor repairs have been necessary, and no leaks have occurred on the section of the line protected. C. L. G.

763. Combating Freezing of High-Pressure Gas Lines. W. J. Grissett. *Petr. Eng.*, March 1937, **8** (6), 132.—Running a small quantity of oil from the high-pressure separator into the high-pressure gas lines in cool weather has overcome successfully and economically the freezing of the lines. From 5 to 12 brls. of oil were all that were required.

From experiments it was found that it is best to take oil from near the top of the liquid level in the separator, the oil line from right feed to gas line should be of ½-in. pipe or larger, where heavy or cut oil is used a blow-off valve is necessary to keep the line open and heavier oils are more efficient than lighter oils and distillates.

L. V. W. C.

Gas.

764. Safety Appliances Feature Californian Gasoline Plant. J. C. Albright. *Nat. Petr. News*, 10.2.37, **29** (6), 64.—Description of the Texas Company's natural gasoline plant near Pico, California, emphasis being laid on those features of the plant that have special devices, etc., intended to reduce accidents and other hazards.

W. W.

765. Absorption of Gases in Packed Towers. T. H. Chilton, H. R. Duffey and H. C. Vernon. *Ind. Eng. Chem.*, 1937, **29** (3), 298.—Experiments were carried out on the absorption of ammonia from an air–ammonia mixture (5% by volume of ammonia) using 4-foot and 8-foot depths of two types of solid packing, in towers 3, 6 and 11·5 in. in diameter at an air rate of 2 ft. per second and a water rate of 1 gallon per minute per sq. foot. The packings consisted of spheres and crushed stone, and were used in various sizes. Values of the film transfer coefficient ranging between 0·11 and 0·29 lb. mole per (hour) (square foot) (atmosphere) were obtained.

It was found that there was little difference between the efficiency of equivalent sizes of spheres and crushed stone, but in general the pressure drop is higher for the latter.

Tower diameter is without effect on the efficiency, provided the initial liquid distribution is satisfactory and the ratio of tower diameter to packing diameter is 8 : 1 or greater

For a given packing $K_G a$ increases with the 0·5 to 0·6 power of the surface per unit volume. P. D.

766. Patents on Gas. G. W. Johnson. E.P. 463,200, 24.3.37. Method of cooling gases especially those containing large quantities of water vapour.

G. W. Johnson. E.P. 463,263, 25.3.37. Wet purification of coal distillation gases.

W. S. E. C.

Crude Petroleum.

767. Correlating and Showing Crude Oil Assay Data. S. D. Turner and F. C. Canant. *Oil & Gas J.*, 25.3.37, **35** (45), 86.—A description is given of a method of showing diagrammatically any particular properties of fractions of a crude oil from which the same properties of any combination of fractions can be determined. A plot is made, taking the percents corresponding to the front cut fractions as abscissæ and the percents corresponding to the heavy ends as ordinates. Isometrics are then drawn representing any desired tests or properties. The charts can be used for ascertaining, *e.g.* the gravity of a cut of any desired width, vapour pressures and octane numbers of gasoline fractions, aniline points of gas oil fraction, viscosity of kerosine fractions, etc.

C. L. G.

768. Characteristics and Yields of North Louisiana Crude Oils. A. W. Trusty. *Oil & Gas J.*, 25.3.37, **35** (45), 119.—A summary is given of the yields and more important properties of products from 18 North Louisiana crudes. In general, the oils are of paraffin base with a few of naphthene or intermediate-paraffin base, and have low sulphur contents. The gasoline (yields 0–32%) require blending with natural gasoline to meet volatility requirements, but rarely need any refining treatment. High yields of kerosine (up to 40%) are given by some crudes, these oils having low sulphur contents, good stability and burning qualities. Rodessa, Caddo, Bellevue and Urania crudes yield lubricating oils and the three last mentioned high-quality asphalts. Notes are given on the producing depths and importance of the different fields, and in some cases details of the more important products from the crudes. C. L. G.

769. Petroleum Emulsions and their Chemical Resolution. C. H. M. Roberts. *Petr. Eng.*, March 1937, **8** (6), 57.—Emulsions, of whatever type, consist of small drops of the dispersed phase, suspended in the continuous or external phase. When crude oil and brine are produced together the formation of emulsions is to be expected. In addition the characteristics of an emulsion are constantly changing, from the moment of its formation to the instant of its complete resolution.

A brief examination of emulsions and their chemical resolution will show that the subject, in its scientific aspects, is one of great complexity and each of the factors concerned must be considered if success is to be achieved. In its practical aspect, however, the chemical resolution of emulsions is a process of great simplicity, provided that the fundamental principles upon which it is based are adhered to.

L. V. W. C.

770. Chemical, Physical Methods of Removing Salt from Crudes. E. R. Jones. *Oil & Gas J.*, 29.4.37, **35** (50), 51.—The acidization of wells in limestone structures has resulted in an increase in the chloride content of crudes causing more intense corrosion (or more expensive methods of control) or deposition in heaters, heat exchangers and condensers. It also affects the quality of the road oils and asphalts manufactured, as they may not meet the solubility requirements. The salt exists in the crude in a water solution emulsified with the crude, and also in crystalline form probably surrounded by wax crystals or amorphous wax.

Settling of the crude, particularly straight from the well, lowers the salt content considerably, the reduction being greater in the summer than in the winter, and suggesting the possibility of heat treatment. This, however, does not remove salt in the crystalline form. The addition of fresh water followed by heating, however, removes these to a large extent. Soda-ash solution may be used to break down the oil film which prevents the water drops from coalescing. Dehydration under such conditions was found to remove 59·7–70·2% of the salt, whilst at lower temperatures (145° F.) only 45·0% was removed. C. L. G.

771. Extracting Salts from Charging Stocks by Electrical Process. G. B. Hanson. *Oil & Gas J.*, 29.4.37, **35** (50), 53.—A description is given of an electrical de-salting process, in which the oil is mixed with water and passed to an electric treater, where it is subjected to a high potential electrical field. Using 5–20% of water, the salt

content is reduced by 90–98%. Typical operating conditions include: temperature 130–200° F.; power consumption 1·5–2·5 kW.; potential between electrodes 33,000 volts, and between electrode and grounded treater shell 16,500 volts; capacity of unit 1500–2000 brl. per day.

The effects on refinery operating of using de-salted crude include: (1) improvement in asphalt quality, (2) longer and more uniform operating periods, (3) elimination of corrosion, and (4) saving in fuel. The results in some commercial installations are given showing the improvements and economies effected, these including: increase in solubility of asphalt from 99·50% to 99·95% or better; reduction in ammonia usage and almost complete elimination of corrosion and increase in length of possible runs of cracking units by over 300%. C. L. G.

Cracking.

772. Heat of Reaction of Cracking Petroleum. H. M. Weir and G. L. Eaton. *Ind. Eng. Chem.*, 1937, **29** (3), 346.—Experiments were carried out in a continuous flow calorimeter to determine the heat of reaction when cracking three different stocks (E. Texas gas oil, Barbers Hill gas oil and Recycle gas oil) under a pressure range of 40–740 lb. per sq. in. and temperature range 930–1250° F.

The results indicate that temperature is not of prime importance in its effect on the heat of reaction when weight of gas and naphtha (410° F. E.P.) produced is taken as a measure of the amount of reaction. Pressure and depth of cracking are of greater significance. When attention is focussed on the molecular bonds broken and the heat of reaction is expressed as B.T.U. per pound mole of new material produced the pressure factor drops out, leaving only type of stock and depth of cracking as important variables. P. D.

773. Patents on Cracking. A. P. Sachs. U.S.P. 2,072,131, 2.3.37. Improved reaction chamber for cracking operations.

E. F. Nelson. U.S.P. 2,072,378, 2.3.37. Process for conversion and coking of hydrocarbon oils.

D. H. Mace. U.S.P. 2,072,524, 2.3.37. Combined liquid and vapour-phase cracking system of the "coil-drum" type.

J. G. Althor. U.S.P. 2,075,599, 30.3.37. Cracking and coking of hydrocarbon oils and coal.

E. F. Nelson. U.S.P. 2,072,123, 2.3.37. P. H. Sullivan. U.S.P. 2,072,805, 2.3.37. A. P. Sachs. U.S.P. 2,073,456, 9.3.37. Cracking of hydrocarbon oils for the production of anti-knock motor fuel.

D. L. Thomas. U.S.P. 2,072,535, 2.3.37. L. De Florez. U.S.P. 2,074,539, 23.3.37. Radiant heat stills for distilling hydrocarbon oils.

D. M. Evans. U.S.P. 2,073,447, 9.3.37. Control device for hot-blast stoves for cracking operations.

S. S. Smith. U.S.P. 2,073,908, 16.3.37. Apparatus and method for controlling rectification.

M. H. Arveson. U.S.P. 2,074,529, 23.3.37. Use of molten metal as a heat transfer medium.

J. C. Black. U.S.P. 2,075,164, 30.3.37. Container for cracked oil consisting of an alloy of Cr, Ni and Fe to resist corrosion by sulphur compounds.

M. W. Barnes. U.S.P. 2,075,601, 30.3.37. Improved cracking furnace.
W. S. E. C.

Hydrogenation.

774. Italy's Petrol Resources. Hydrogenation of Albanian Crude. Anon. *Chem. Trade J.*, 14.5.37, **100**, 423.—According to a detailed account of developments in Italy, given by G. Fauser to the Lombardy Section of the Italian Association of Chemistry, the hydrogenation process has been successfully adapted to the production of first-grade motor gasoline from rather intractable Albanian crude, whilst substantial quantities of lubricating and fuel oils are also produced. Oil reserves at Devoli, on the River Gruka, have been estimated at some 12 million tons. At present over 100 wells are in active production, and the oil from the various wells is piped 74 kilometres to Valona, on the coast, from whence it can readily be shipped to Brindisi. The crude is asphaltic base with a high sulphur content. By distillation and cracking it yields 40% max. of gasoline, the residue being heavy oil and coke of very little commercial value. Heavy losses are incurred in refining the gasoline, owing to its high sulphur content. Small-scale and pilot-plant hydrogenation tests having shown promise, a semi-industrial plant was erected at Novana. This showed the possibility of obtaining from the crude 80% of gasoline low in sulphur content and equal to market requirements in octane number and gravity. It was then decided to build plants at Bari and Leghorn, each with an output of 120,000 tons of gasoline, in addition to lubricating oil, paraffins and liquid gases. The crude is first distilled in a rectifying column yielding a little crude gasoline, a middle oil and a heavy residue. The middle oil is hydrogenated in the vapour phase to gasoline and permanent gas. The heavy residue is submitted to vacuum distillation. The distillate (27% of crude) is hydrogenated in the liquid phase yielding mainly lubricating oil, but also quantities of gasoline, diesel oil and paraffins. The asphaltic residue is hydrogenated in the liquid phase under special conditions, yielding mainly gasoline. Supplies of middle oil are to be reinforced by installation of cracking plants.

The waste permanent gases from the reactions are purified from sulphur, which is recovered. The residual gas (largely methane) is mixed with a definite proportion of steam and converted catalytically at 800° C. into a mixture of CO and H_2. By a second catalytic furnacing at 500° C. the CO in the presence of steam is converted into a mixture of CO_2 and H_2. The gas is then cooled to separate excess water vapour, compressed to 28 atmos. and the CO_2 removed by water scrubbing. The H_2 is compressed in stages to 300 atmos., and residual CO removed by washing with an ammoniacal copper solution. In this way the hydrogen necessary for the liquid phase units is recovered from the waste gases. R. A. E.

Refining and Refinery Plant.

775. Heat Transfer and Pressure Drop in Rectangular Air Passages. L. Washington and W. M. Marks. *Ind. Eng. Chem.*, 1937, **29** (3), 337.—Heat transfer and pressure drop determinations were made on the flow of air through rectangular channels of height a and width b. The gap b, varied between $\frac{1}{2}$ and $\frac{9}{16}$ in. Heat transfer took place only through the "a" walls of the passage, the "b" walls being made of non-conducting material.

As in round pipes the isothermal flow is viscous if the Reynolds Number Re is less than 2300. When heat is applied the flow is viscous up to Re = 3400, and is not fully turbulent until Re reaches 13,000.

Within the limits of the data, at a given velocity in viscous flow, an increase in b produces an increase in the surface coefficient and a decrease in the friction gradient. In turbulent flow the friction gradient also decreases as b increases, but the relation between h and b is indeterminate. In both types of flow the friction factor increases with increase of b. Heating increases the friction factor in viscous flow, but does not affect it appreciably in turbulent flow. P. D.

776. Factors in High-Pressure Design. C. W. Seibel. *Ind. Eng. Chem.*, 1937, **29** (4), 414.—The design of high-pressure equipment is outside the province of the average engineer, but nevertheless many occasions arise when it is necessary that he should be familiar with the general principles. The author deals with compressor design in some detail, and more generally with piping, constructional materials for both high-

and low-temperature duties, design of pressure vessels, heat exchangers for gas–gas interchange, flanges, bolts and gaskets, and safety disks. P. D.

777. Fluid-Flow Design Methods. R. P. Genereaux. *Ind. Eng. Chem.*, 1937, **29** (4), 385.—For purposes of plant calculations the relation between the friction factor in Fanning's equation and the Reynolds Number can be expressed by a single equation of the exponential type. From a consideration of the majority of the published data on flow in the turbulent region the author adopts the equation $f = 0{\cdot}04\mathrm{Re}^{-0{\cdot}16}$ as representing the data to the best advantage, and using this as a basis a nomogram is constructed which facilitates the determination of pressure drop in clean steel pipes.

A nomogram from which the economic pipe size may be calculated is also given. This is based on certain assumptions as to the fixed cost of pipe, the variation in cost with diameter, and the cost of power. P. D.

778. Counter-current Liquid–Liquid Extraction in a Packed Tower. J. H. Rushton, *Ind. Eng. Chem.*, 1937, **29** (3), 309.—The results of a series of batch and batch counter-current extractions (1, 2, and 3 stages) of an oil with nitrobenzene are plotted on rectangular co-ordinates using V.G.C. and volume per cent. of nitrobenzene as axes. The results of the batch counter-current extractions were not in agreement with predictions made according to the suggestions of Saal and Van Dyke and of Hunter and Nash.

From the resulting graphs a chart is drawn applicable to this particular system, which is then used to assess the efficiency of a packed glass tower $2\frac{1}{8}$ in. (int. diameter) 6 ft. long.

The exeunt liquids are not of the same composition as would be obtained if the operation were carried out using perfect stages, the extract layer being richer in nitrobenzene than the corresponding saturated mixture obtained in the batch counter-current experiments, and the raffinate layer poorer. This deviation from saturation is used to obtain a figure for the percentage efficiency of the solvent. Figures are also given for the number of equivalent stages (E.T.S.) for the column using various sizes of glass stoneware or carbon ring packing, and for the limiting rate before flooding occurs.

The following conclusions are reached.

(1) There is little difference in extraction using glass, stoneware or carbon of equivalent size.

(2) Graded packing (larger at the bottom and smaller at the top) gives better results than uniform packing.

(3) Recirculation of extract and mixing it with the incoming oil increases oil throughput and E.T.S.

(4) Settling spaces required are small and are dependent on the size of packing nearest the space.

(5) For a given size of packing, as the solvent ratio increases the E.T.S. and per cent. efficiency both increase, the former most noticeably.

(6) Low interface levels (or large continuous raffinate phase) give highest E.T.S. and per cent. efficiency.

(7) For a given height of packing, as the oil rate increases the E.T.S. and per cent. efficiency also increase, the former most noticeably.

(8) Preferential wetting of the packing seems to have no appreciable effect on the extraction. P. D.

779. Performance of Spray and Packed Columns. F. J. Appel and J. C. Elgin. *Ind. Eng. Chem.*, 1937, **29**, 451.—Benzoic acid was extracted from toluene by means of water in spray and packed columns. The results obtained demonstrated that the capacity of a spray column depended on the rates of feed of both the discontinuous and continuous solvents, on the flow ratio, and especially on the size of drops of the discontinuous solvent produced by the entrance nozzle. In the packed column, the capacity was found to depend mainly upon the rate of feed of the discontinuous solvent and varied inappreciably with the drop size produced by the nozzle. A spray column may be either more or less effective than a packed column depending on the drop size produced by the nozzle and the nature of the packing. J. W. H.

780. Duo-Sol Process. Anon. *Petr. Times*, 17.4.37, **37** (953), 507.—The article comprises, chiefly, a survey of the difficulties met with in the operation of a commercial unit employing the solvent extraction process. The solvents used were propane and "selecto" a mixture of cresylic acid and phenol. Experience has shown that the process requires the most careful and expert handling. Emulsification, either complete or partial, was responsible for most of the difficulties. Proper control of water contents, solvent ratios, temperatures, settling times, the phenol content of the "selecto," etc., did much to minimize trouble from this cause, but the problem has not been finally solved. The recovery side of the unit presented no difficulties that were not solved in a fairly straightforward fashion. H. G.

781. Modernization of Electrical Dehydrator Equipment. F. D. Mahone. *Petr. Eng.*, April 1934, **8** (7), 108.—In addition to improvements in the safety and serviceability of electrical dehydrator equipment, progress has been made in the development of flow line treatment, using waste heat and full automatic control.

Descriptions are given of the different types of equipment used in ten electrical dehydration units. C. L. G.

782. Refineries Operating in the U.S.A. Anon. *Oil & Gas J.*, 25.3.37, **35** (45), 173.—A list is given of Refineries operating in the U.S.A., Canada and Mexico. The U.S.A. and Canadian refineries are shown under the state in which the plant is located. The list shows the company operating, location, crude capacity, cracking capacity and type of cracking process employed. In addition, notations indicate whether the refinery is a complete plant, *i.e.* capable of manufacturing gasoline, kerosine, gas oil, fuel, lubricating oils, wax, and perhaps also asphalt and coke, or whether it is only capable of producing certain of these products. R. A. E.

783. Producing and Refining of Petroleum in Pechelbronn. Anon. *Oil & Gas J.*, 1.4.37, **35** (46), 44.—The geology and history of the exploitation of the Pechelbronn oilfield in Alsace are briefly described and notes given on the present methods of production and refining.

The field has been worked since 1735, at which time the oil obtained from galleries and shafts was separated from the sand by boiling. In 1813 exploratory wells were drilled through the bituminous sands, and in 1882 a gusher of more fluid oil was struck. In 1857 the first kerosine stills were erected. Present production is by wells and mining galleries, more than 2000 wells having yielded 1,550,000 metric tons. Oil not pumped from the sands is recovered in sumps dug every 32 ft. The oil contains 35% salt water and earth in suspension, and is settled in steam-heated tanks, chemically de-emulsified and finally dehydrated. The refinery is in three sections, in each of three adjacent villages. In the first refinery the crude is passed to a still where the temperature is raised to 356–374° F. and gasoline taken off, and thence to a further still, heated to 554–570° F., where kerosine is taken off. The residue goes to a second refinery by pipe-line, where it is vacuum distilled in a five-still continuous bench into lubricating oils, distillate and asphalt. Wax is recovered from the distillates, sweated and refined. The gasoline is caustic-refined, and the kerosine acid and soda are refined, whilst the dewaxed lub. oil distillates are redistilled, acid, soda and clay treated. The asphalts from the primary distillation have melting points of 104–248° F. Some of the residue is cracked to produce gasoline and coke for electrode manufacture.

Details of the storage and shipping laboratory facilities are given.

In 1936 Pechelbronn supplied 10·1% of the kerosine, 12·5% of the lubricating oils, 28·5% of the paraffin needs of the French market. C. L. G.

784. How to Baffle Vertical Refinery Boilers. W. F. Schaphorst. *Petr. Eng.*, March 1937, **8** (6), 49.—A modified sketch of an incorrectly baffled vertical water-tube boiler illustrates an improved method employing less baffling, and resulting in more cross flow with fewer turns. Horizontal baffles and pockets should be avoided owing to the difficulty of removing ashes, soot, etc. Solid baffle walls should be avoided owing to expansion and contraction. Plastic with leakless snake joints is recommended for all kinds of water-tube boiler baffling to allow for expansion and contraction. Baffles of this type are still in good condition after 15 years' operation at continuous overload.
C. L. G.

785. Wax Precipitation from Propane Solution. A. P. Anderson and S. K. Talley. *Ind. Eng. Chem.*, 1937, **29**, 432.—The conditions most suitable for the continuous filtration of Midcontinent residuum have been determined by means of a small batch filter, and the results correlated with the microstructure of the wax. It was found that the most easily filterable wax is made up of clusters, which consist of wax grains cemented together by naturally occurring aromatic resins. The precipitation of wax in this form was found to be favoured by: (*a*) complete solution of the oil in the propane before chilling; (*b*) chilling the propane–oil mixture by evaporation of the propane; (*c*) avoiding instantaneous or flash chilling; (*d*) avoiding precooling the propane–oil mixtures to temperatures within the range 75–100° F.; (*e*) gentle agitation, avoiding violent churning; (*f*) the presence of the correct proportion of the aromatic cementing material.

Providing no gel is formed the propane–oil ratio does not appear to be important. J. W. H.

786. Safety in the Chemical Industry. J. Davidson Pratt. *Chem. Trade J.* 26.3.37, **100**, 266.—In a discussion of the dangers due to the explosion of various gases, vapours, etc., used in the chemical industry and of recommended safety precautions, the following figures are given for the approximate limits of inflammability in air in percentages of the vapour by volume: acetone 2–13, acetylene 3–82, benzole 1·4–8, carbon bisulphide 1–50, carbon monoxide 13–75, coal gas 8–23, ether 2–48, ethyl alcohol 3·5–18, hydrogen 7–75, methyl alcohol 6–36, and petrol 1·45–6·2. C. L. G.

787. Use of Nickel in the Petroleum Industry. R. C. Stanley. *The Nickel Industry*, 1936, 17–19.—In a booklet published by the International Nickel Company of Canada, Ltd., forming an annual survey of the nickel industry, a section deals with the use of nickel in the Petroleum Industry. Portions of plant and equipment made from nickel steels, nickel-chromium steels, nickel-molybdenum steels, nickel irons, Monel metal and Inconel are mentioned, and show the growing variety and volume of nickel alloy applications in the Petroleum Industry. W. W.

788. Monel Metal in the Oil Industry. R. Müller. *Oel und Kohle*, 1937, **13**, 325–329.—The mechanical and chemical properties of metals of the Monel type are described with respect to their suitability for refinery plant construction. The corrosion resistance of these alloys is especially valuable in this field. P. G. H.

789. Patents in Plant. A. R. Blakey. U.S.P. 2,072,093, 2.3.37, and U.S.P. 2,072,834, 2.3.37. J. S. Wallis. U.S.P. 2,073,258, 9.3.37. E. Ellsberg. U.S.P. 2,073,446, 9.3.37. Apparatus for fractional distillation of petroleum oils. W. S. E. C.

Chemistry and Physics of Petroleum.

790. Physical Characteristics of Naphthene Hydrocarbons. W. L. Nelson. *Oil & Gas J.*, 1.4.37, **35** (46), 38.—A list is given of the mol. wt.; sp. gr. at 60/60° F.; boiling pt.; melting pt.; latent heat; heat of combustion and octane no. of a series of naphthene hydrocarbons from *cyclo*propane to hexamethyl *cyclo*hexane. C. L. G.

791. Molecular Weights of Viscous Petroleum Fractions. J. R. Keith and L. C. Roess. *Ind. Eng. Chem.*, 1937, **29** (4), 460.—Molecular weights of fractions from Midcontinent and Texas Coastal crude, having viscosities between 36 and 150 Saybolt seconds at 210° F. were determined cryoscopically using benzene and *cyclo*hexane as solvents. For each crude molecular weight is plotted against viscosity at 100° F., and the results finally correlated in terms of viscosity at 210° F. and slope of the viscosity-temperature line on the A.S.T.M. chart. The correlation agrees satisfactorily with previously published data. P. D.

792. Heats of Combustion of the Liquid Normal Paraffin Hydrocarbons from Hexane to Dodecane. R. S. Jessup. *Bur. Stand. J. Research*, 1937, **18**, 115–128.—Accurate values of the heats of combustion of organic compounds are of importance in chemical

thermodynamics, chiefly as a means of calculating the heats of formation of the compounds from which, with a knowledge of the entropies of formation, the free energies of formation may be derived.

These measurements were made by means of a bomb calorimeter, calibrated electrically for some of the experiments, and by burning standard benzoic acid for the remainder. The samples were enclosed in thin-walled glass bulbs flattened on opposite sides and filled completely, and were ignited by an electric fuse of iron wire. The oxygen used for the combustion was freed from combustible materials and CO_2. Measurements were made of the CO_2 and CO formed in the combustion, and indicated that the liquids contained very little inert impurity and that combustion was practically complete.

Each observed value of the heat of combustion was reduced, by the Washburn correction, to the difference in the internal energies of the initial system—liquid hydrocarbon and gaseous O_2 at 30° C. and 1 atmosphere pressure and the final system—gaseous CO_2 and liquid H_2O each separately at 30° C. and 1 atmosphere pressure.

The empirical equation

$$-\Delta H_{25^\circ\,C.} = 259{\cdot}28 + 648{\cdot}84n + 0{\cdot}2587n^2$$

where $-\Delta H_{25^\circ\,C.}$ is the heat of combustion in international kilojoules per mole of liquid normal C_nH_{2n+2} in gaseous O_2 at 25° C. and 1 atmosphere pressure, the products of combustion being gaseous CO_2 and liquid water under the same conditions, n is the number of C atoms per molecule—reproduces the mean values within 0·02%.

The final experimental values are estimated to be accurate within 0·03 or 0·04%.

D. L. S.

783. System Methyl*cyclo*hexane-Aniline-*n*-Heptane. K. A. Varteressian and M. R. Fenske. *Ind. Eng. Chem.*, 1937, **29**, (3), 270.—In this system aniline is the solvent in which methyl*cyclo*hexane is more soluble than *n*-heptane. The phase diagram is constructed at 25° C. and 1 atmosphere partial pressure, and various relationships are adduced which are amenable to analytical treatment. The two components methyl*cyclo*hexane and *n*-heptane give mixtures obeying Raoult's Law, and so may be separated by fractional distillation or by solvent extraction. The efficiency of the two processes is examined.

Although the simple distribution law does not hold with aniline as a solvent, it is found that the two distribution coefficients bear a constant ratio to each other, which allows the problem of estimating the separation to be approached in a similar manner to that of calculating the separation in fractional distillation using the concept of relative volatility. Relationships are derived for the cases of minimum reflux and minimum number of plates. For the intermediate case a graphical method is given. Starting with the plot on triangular coordinates, and applying the method described by Hunter and Nash, the authors, and others, it is possible to construct a diagram of the McCabe and Thiele type applicable to the case of extraction. Such a diagram brings forward the concept of reflux ratio in such operations.

As an example of the value of solvent extraction in making such separations, the separation of a 50–50 mixture of the two components by extraction is compared with the separation by distillation. In order to produce a product containing 90% by weight of heptane and a residue containing 90% by weight of methyl*cyclo*hexane, a packed tower 25 ft. high is needed for separation by extraction, as against 42·5 ft. when distillation is employed, whilst the heat requirements are 58,200 B.T.U./hr. and 418,000 B.T.U./hr. in the two cases when a throughput of 100 lb. per hour of feed is considered.

P. D.

794. Conditions at a Liquid–Liquid Interface. L. C. Strang, T. G. Hunter and A. W. Nash. *Ind. Eng. Chem.*, 1937, **29** (3), 278.—The flow of a liquid between a solid and a fluid boundary was investigated experimentally by flowing water down the inside face of a vertical tube with a central core of oil. The point where turbulence sets in does not occur at a fixed value of the Reynolds number, but depends on the nature of the fluid forming the fluid boundary. The appearance of waves at the interface furnishes a visual indication of the onset of turbulence.

For a liquid in streamline flow the ratio of the velocity at the liquid–liquid interface to the average velocity of the flowing liquid decreased with increasing velocity of the liquid forming the boundary.

P. D.

Analysis and Testing.

795. Separation of Constant-boiling Mixtures of Naphthene and Paraffin Hydrocarbons by Distillation with Acetic Acid. S. T. Schicktanz. *Bur. Stand. J. Research*, 1937, **18**, 129–136.—Glacial acetic acid which is a highly molecularly associated compound has been found very effective as a third component in the separation of constant-boiling fractions of gasoline consisting of naphthene and paraffin hydrocarbons. Although it boils at a low temperature, 118·1° C., it tends to form azeotropes with hydrocarbons boiling over a considerable temperature range, and can be used successfully for the separation of fractions normally boiling in the range 130–174° C.

A gasoline fraction consisting essentially of paraffins and naphthenes was obtained by removing the aromatics and then subjecting to systematic distillation. The portion boiling 130–174° C. was distilled with acetic acid. The azeotropic mixtures formed by the hydrocarbons and the acid assisted in separately concentrating the paraffin and naphthene groups which, although never absolutely pure, could be separated further by other physical methods. D. L. S.

796. Analysis of Mixtures of Methanol–Ether–Water. S. Doldi. *Chimica e Industria*, 1937, **19**, 6–9.—Various methods which have been suggested for the analysis of alcohol–ether–water mixtures are surveyed with references to the literature. In general, these methods are not very satisfactory, and most of them are not applicable to mixtures of all compositions. The author describes a tentative method based on the determination of specific gravity and refraction. The results are expressed in the form of a triangular diagram, which is divided into two zones by a curve corresponding to the 17·5° C. isotherm. One zone represents mixtures which are stable at this temperature, whilst mixtures corresponding to points in the other zone are not homogeneous at this temperature. C. C.

797. Derivation of Kinematic Viscosity from Commercial Values. H. Vogel. *Oel und Kohle*, 1937, **13**, 153–155.—With the aid of measurements published by the A.S.T.M. and by McCluer and Fenske, the author shows that his conversion formula, originally proposed for Engler values, may be applied to the Saybolt instrument.

It is impossible, however, to devise a conversion table for Saybolt viscometers as a class, but for each instrument a table, involving knowledge of the water value and an apparatus constant, may be derived. A complete example is worked out when it was found that

$$\text{Kinematic viscosity} = \frac{S}{29{\cdot}3} \times 6{\cdot}32^{\left(1-\frac{29{\cdot}3}{S}\right)},$$

where S = Saybolt seconds. P. G. H.

798. New Method for Calibrating Saybolt Viscometers. C. F. Bonilla. *Nat. Petr. News*, 7.4.37, **29** (14), 79.—Applying Poiseuille's Law to the Saybolt viscometer and ignoring Kinetic corrections

$$\frac{\mu}{\rho} = \frac{gd^4S}{32lD^2\left(-ln\left(1-\frac{240}{\pi D^2L}\right)\right)} = AS$$

where d = int. diam. in cms. efflux tube, l = length, cm. efflux tube, D = int. diam. cm. oil tube, L = initial oil head cm., μ = viscosity in poises, ρ = density of oil grm./c.c. S = Saybolt viscosity, secs. g = gravitational constant, A = constant. By substituting the standard dimensions $A = 0{\cdot}00234$. Hence the accuracy of an instrument may be checked by determining the significant dimensions and applying the above equation. An increase of 1% in a single dimension involves the following error in the viscosity determination. $d - 4{\cdot}0$, $l + 1{\cdot}0$, $D - 1{\cdot}8$, $L - 1{\cdot}9$, $V + 1{\cdot}9$. (V = volume of the receiver). Methods are given for the accurate checking of dimensions. H. G.

Motor Fuels.

799. Value of Octane Numbers in the Air. D. P. Barnard. *Nat. Petr. News*, 31.3.37, **29** (13), 65.—A critical survey of the economic aspect of the octane number of aero-engine fuel is given. It is stressed throughout that the advantage represented by an increase in octane number is gained only when the requisite change in engine design is made. The following conclusions may be drawn. (1) Octane number improvements make possible advances in engine design and aeroplane carrying capacity of sufficient magnitude to determine further trends with a high degree of certainty. (2) Depending on the type of 'plane and conditions of operation, the value of an increase of one octane number is from 2 to 8 cents per gallon. (3) For moderate octane numbers an increase in the compression ratio appears to offer a slight advantage over supercharging. With fuels of octane number exceeding 100 increase in supercharge produces a greater advantage than an increase in C.R. (4) A decrease of 1% in the calorific value of a fuel is equivalent to a reduction of 2 octane numbers. Hence the use of such fuels as alcohol to increase octane rating has its concomitant disadvantage in loss of energy value. (5) It is suggested that the economic gains to be obtained by further increases in ignition quality of fuels is so much greater than the probable cost of producing the improvement that those increases are certain to come. H. G.

800. Shell Manufacture 100 Octane Motor Fuels on Large Scale. Anon. *Oil & Gas J.*, 25.3.37, **35** (45), 108.—The principal refineries of the Shell organization have achieved commercial production of 100 octane aviation fuel possessing important advantage for modern aircraft. This has been accomplished by the development of high capacity apparatus for the synthesis of 2 : 2 : 4-trimethylpentane, *i.e. iso*-octane. When this hydrocarbon was proposed as the high standard reference fuel for engine rating of gasolines, the cost was so high that even for laboratory use it was found advantageous to resort to secondary standards prepared at a lower cost. The synthesis is achieved by effective catalytic polymerization methods to produce olefins of high purity for hydrogenation to the desired compound. Numerous U.S. and world speed records broken by aeroplanes using 100 octane aviation gasoline are detailed. Results of tests carried out by Klein of U.S. army comparing 87 and 100 octane fuels using 500-h.p. engines at 2200 r.p.m. show the following advantages of the latter : (1) lower cylinder temperature at high power output, (2) lower specific fuel consumption (over 20%) at constant power output, (3) greater power output (over 14% at a given specific fuel consumption), (4) greater payload with reduced fuel load. Horse-power output has increased approximately 33⅓% per unit weight with a corresponding increase in antiknock value of fuels from 73 to 87 octane for commercial grades during the last several years. Until the development of 100 octane fuel, the highest octane grade specified was Air Corps 92, which is only about 2 octane numbers higher than 87 commercial grade when tested by A.S.T.M. method. Thus, the future of air transport depends in no small measure on continued improvement of hydrocarbon fuels, which must be manufactured under strict specification. R. A. E.

801. Antioxidants as Stabilizers for Cracked Motor Fuels. C. G. Dryer, J. C. Morrell and G. Egloff. *Oil & Gas J.*, 25.3.37, **35** (45), 113.—Antioxidants have been successfully used in cracked gasolines in the U.S. for a number of years. In small concentrations they prevent gum formation, deterioration of colour and loss of antiknock value. Main requirements of an antioxidant are :

(1) Satisfactory inhibiting value at minimum cost.
(2) The most desirable form is a liquid or a concentrated solution readily soluble in gasoline.
(3) Low solubility in water.
(4) To be unaffected by presence of alkaline water.
(5) Should not decrease initial colour of gasoline, but should protect against darkening in storage and occasion minimum discoloration on exposure to light.
(6) Should be sufficiently volatile to avoid formation of deposits in carburettor jets, etc. Among inhibitors which have gained commercial acceptance are U.O.P. inhibitors 1 and 4. The latter is specially developed for use in cracked gasoline. A

large number of tests have been carried out to compare inhibitor 4, catechol and inhibitor 1.

As regards oxygen bomb stability, the ratios of effectiveness are: 6/10 : 3·5 : 1. Average percentages of inhibitor removed on shaking inhibited gasoline for 10 mins. with 10% of distilled water are 11%, 94% and 35%, respectively. Oxygen bomb stabilities after this extraction were determined, and are recorded. Similar tests were carried out using 5% by vol. of a 1% NaOH solution instead of water, and show inhibitor 4 again to be most resistant. The most general method of employing an inhibitor is to sweeten the stabilized gasoline, settle thoroughly and add inhibitor as it is pumped from rundown to storage tanks. Sometimes a light acid treatment is necessary to give a water-white product. As control methods for prediction of storage stability a combination of induction period, *i.e.* oxygen bomb stability, and copper dish gum content is recommended. As a general rule, a minimum induction period of 240 mins. is satisfactory, and if the gasoline has not been chemically refined, at least 150 mins. should be added to the original induction period by application of inhibitor. The copper dish gum content should not exceed 25 mgms. as determined by the method of the Atlantic Refining Co. The results of application of inhibitors 1 and 4 to various acid-treated, clay-treated and untreated cracked gasolines of American, Roumanian and Mexican origin are tabulated. The U.O.P. process of treating cracked gasolines with aqueous HCl in the presence of brass yield products particularly stable as regards gum content and induction period, and also show high inhibitor susceptibility. R. A. E.

802. Patent Literature on Gum Inhibition. J. H. Byers. *Nat. Petr. News*, 17.3.37, **29** (11), 157, and 14.4.37, **29** (15), 58.—The long list of bodies for which gum inhibiting properties are claimed includes many different classes of compound. Only one patent mentions inorganic material, viz. hydrated lime, calcium carbonate or ammonia. Among the bodies cited are amines, amides, imines and numerous other nitrogen bases, a class of compound which predominates. Other classes are phenols, and substituted hydroxy bodies, azo-, hydrazo-compounds, poly-substituted aromatics, sulphur and halogenated compounds. A complete survey of the U.S. patent literature filed up to February 1937 is included. H. G.

803. Old Railway Sleepers as Fuel. Anon. *Gas & Oil Power*, March 1937, **32** (378), 66.—Tests have been carried out in France on the suitability of railway sleepers carbonized by the "Geka" process as fuel for automotive gas producers fitted to lorries, tractors, etc. Creosoted sleepers are carbonized in refractory-lined brick kilns yielding Geka charcoal of fixed carbon content 92–93% and 2·4% of ash. The calorific value is 14,400 B.T.U. per lb.

Bench tests with various engines and producers on different grades of charcoal gave the following figures for fuel consumption per hour per B.H.P.: Average commercial charcoal 1·3 lb., selected grade charcoal 1·05 lb., Geka charcoal (creosoted wood) 0·75 lb.

Tests over a number of years on shunting locomotives with different types of charcoal are reported, showing an improvement in consumption from 37 lb. per hour with ordinary charcoal to 21 lb. per hour with Geka charcoal. A 5-ton military lorry with a 35-H.P. engine was run over a 1880-mile course at 21·8 m.p.h. using approx. 1 lb. per mile, a reduction of 25% over ordinary charcoal, whilst a 30-H.P. Caterpillar tractor used Geka charcoal at the rate of 198 lb., as compared with 22 gallons of petrol per day giving a net saving of 175 francs per working day. C. L. G.

804. Patents on Motor Spirit. E. I. Du Pont de Nemours and Co. E.P. 462,593, 8.3.37. Removal of gum-forming constituents from motor spirit by inhibiting the spirit with 0·001–0·006% of *p-cyclo*hexylaminophenol dissolved in methanol or benzol.

I.G. Farb. A.-G. E.P. 463,218, 24.3.37. Corrosion prevention of magnesium or alloys of fuel tanks caused by practically anhydrous motor fuels containing monohydric alcohols, by adding soluble alkali fluorides.

G. W. Johnson. E.P. 463,328, 25.3.37. Production of liquid hydrocarbons from gaseous hydrocarbons by first partly dehydrogenating above 500° C. a normally gaseous

paraffin hydrocarbon in a tubular space and then polymerizing the dehydrogenated products.

P. C. Keith, Jr. U.S.P. 2,072,456, 2.3.37. Stabilization of hydrocarbon distillates.

F. Gardner. U.S.P. 2,073,147, 9.3.37. Removal of mercaptans from light distillates by adding an aqueous solution of sodium plumbate without the addition of sulphur.

O. F. Simons and W. H. Bahlke. U.S.P. 2,073,517, 9.3.37. Solvent fractionation of gasoline with liquid SO_2 at 0–125° F. in the presence of liquefied propane.

E. J. Houdry. U.S.P. 2,072,108, 2.3.37. Production of light hydrocarbons from crude oil by first topping the crude to remove straight-run gasoline and fractionating the residue to obtain a middle cut and bottoms. Part of the asphaltic and tarry substances are removed from the bottoms, and the remaining residue is added to the middle cut. This resulting middle cut mixture is transformed to obtain the desired light products and the residual oil treated as before. W. S. E. C.

Lubricants and Lubrication.

805. Connection between Cylinder Wear and Lubricating Oils of Different Viscosity Index, and with Colloidal Graphite Addition. E. Norlin. *Tekn. Tidskr.*, 20.3.37, **66** (*Automobil-, och Motorteknik* No. 2), 9–16.—This paper describes experiments undertaken with a view to correlating the properties of lubricating oils as determined by laboratory tests and actual service performance by comparing oils of paraffin and mixed-base types, and also the effects of addition of colloidal graphite to lubricating oils.

In the first set of experiments a solvent-treated oil of paraffin base type (V.I. = 100) was compared with a mixed base oil (V.I. = 55) in a Citroën, type 7, model 1935. Four tests were run, the first two of about 30 days durations, from July to October 1935, each covering about 300 metric miles (1865 English miles). The first of these were run with paraffin base oil, the second with mixed base oil. In the third and fourth tests the same mileage was covered in about 3 months, from October 1935 to May 1936, the third run with paraffin base oil and the fourth with mixed base oil. Through special arrangements, the maximum crankcase temperature was maintained at 40–65° C. throughout the tests, and the two oils had nearly the same viscosity at 50° C., viz. 78 and 76 centistokes, respectively. Oil samples were withdrawn at regular intervals and inspected, together with the final used oil. At the end of each test the engine was dismantled and the cylinder wear measured by means of a specially designed instrument which could be read to 0·0001 mm. Because of temperature variations and other sources of error, however, it was considered accurate only within 0·001 mm. Three measurements were made, viz. loss of weight of the piston rings, loss in height of the piston rings, and increase in diameter of the cylinder bore. The engine was also visually inspected for carbon, soot and other deposits. The following conclusions were reached: (*a*) loss in weight for the upper piston rings were 63% and loss in height 124% greater for mixed base oil than for paraffin base oil, and the same figures for the lower piston rings were 28% and 40%, respectively, (*b*) cylinder wear, in the upper portions of the cylinders, was 50% greater for mixed base oil than for paraffin base oil, (*c*) the mixed base oil had been oxidized to a higher degree, and had given rise to more carbon and soot deposits than the paraffin base oil, (*d*) comparing these results with laboratory inspections, oil with good viscosity–temperature characteristics and low Sligh Nos. cause less cylinder wear and less carbon and soot formation than oils with poor viscosity–temperature characteristics and high Sligh Nos.

In the second set of experiments, the purpose of which was to determine the effect of addition of colloidal graphite to lubricating oil, two 1936 Chevrolets, of exactly similar construction and type, were driven simultaneously in two runs. A highly refined paraffin base type oil (V.I. = 102) was used as lubricant, 4% of colloidal graphite being added to one car in the first run, and to the other in the second. The maximum crankcase temperature was maintained within 40–70° C., and each run covered approximately 200 metric miles (1250 English miles) in about one month during the period May–August 1936. The oils and engines were inspected as before. The conclusions were: (*a*) wear was consistently greater in one of the cars, (*b*) in all

cases wear in the same car was greater with colloidal graphite than when pure lubricating oil was used, (*c*) cylinder wear was 56 and 49% greater in the two cars when colloidal graphite was used, (*d*) the loss of weight of the upper piston rings were 3 and 150% greater with colloidal graphite, the corresponding figures being 83 and 737 for the lower piston rings, (*e*) the changes in the height of the piston rings were small, but larger for the colloidal graphite.

Further work regarding addition of adhesion-promoting substances and top oil will be published later. R. F. S.

806. Determination of Sligh Number. E. Norlin. *Tekn. Tidskr.*, 13.3.37, **66** (Kemi No. 3), 22–24.—The Sligh Number described in *A.S.T.M. Proceed.*, 1927, p. 461, has been used for several years by the Swedish Government Testing Laboratories as a measure of resistance of oils towards oxidation, and is also included in the official Motor Oil Specifications issued by the Swedish Society of Engineers in November 1935. As a result of the experience gained, modifications in the A.S.T.M. procedure have been adopted, and the present paper describes in detail the technique developed in the Government Laboratories. Two different determinations, performed by two different chemists at different times, must check within 2, 3, or 4 units for oils of Sligh Numbers below 20, above 20, and very high, respectively. R. F. S.

807. Current Research Work on the Solvent Refining of Motor Oils. L. C. Strang. *Oil & Gas J.*, 25.3.37, **35** (45), 98.—Results of research carried out in Birmingham University to investigate the fundamental principles involved in the solvent extraction and dewaxing of lubricating oil are reported. The research has been principally concerned with: (1) the fundamental principles of mass transfer in liquid systems, (2) equilibria and computations for solvent extraction processes, (3) equilibria and computations for solvent dewaxing processes.

Mass transfer investigations were carried out in a double liquid-wetted wall system, the transfer of phenol between kerosine and water being used to examine the fundamentals involved. Conclusions are that mass transfer between two liquids can be treated in the same way as mass transfer between a gas and a liquid, and that the overall resistance to mass transfer in a liquid–liquid system can be considered as made up of two individual film resistances, each dependent on the physical and dynamical properties prevailing in the two liquids.

Graphical representations of equilibria relationships in an oil–solvent system were investigated, and a satisfactory method of representing such equilibria on triangular co-ordinates was devised. Mathematical properties of such triangular diagrams were then investigated, and satisfactory computation methods based on such diagrams were evolved for batch, multiple and counter-current extraction processes applied to a simple three-component system. These methods were then applied successfully to the complex case of an oil–solvent system. The physical property of the extracted oil used as a basis was the V.G.C. constant and the method of construction of the equilibrium diagrams is explained. Results to be expected under given conditions from a given stock can be determined by these methods.

Similarly graphical methods were employed for representing equilibrium relationships in an oil–wax system. A method of calculating the results to be expected from a solvent dewaxing process has been developed. Conditions required for a given stock and solvent to yield oil of a certain pour point may be determined and the yield of dewaxed oil ascertained. Conversely, the yield and pour point to be expected under given conditions may be ascertained. The graphical methods developed for solvent extraction processes have been adopted by many oil companies in Great Britain and in the U.S.A. R. A. E.

808. Solvent Refining is Furnishing Large Share of Motor Oils. C. K. Francis. *Oil & Gas J.*, 25.3.37, **35** (45), 87.—A review is given of the development of solvent dewaxing, extraction and deasphalting processes during the past seven years. Essential requirements for modern lubricating oils are: high viscosity index, no tendency to deposit large quantities of carbon, no sludge formation, fluidity at low temperatures.

In 1930 it would have been difficult to procure any large quantity of oil meeting specifications of this sort, but with the erection of numerous solvent refining units during the last seven years, ample supplies are now available.

Properties of the principal selective solvents used commercially are tabulated. Brief outlines of the processes utilized in dewaxing, extracting and deasphalting are given.

Tables show location, operating company, process utilized and output in brls. per day of solvent extraction and dewaxing plants in operation in the U.S.A. and abroad in March 1937. R. A. E.

809. Lubricating Oil Properties are Improved Electrically. Anon. *Oil & Gas J.*, 25.3.37, **35** (45), 127.—The Société des Huiles De Caval et Roegiers is manufacturing motor oils and a motor-oil additive by utilizing the physico-chemical changes that come in molecular structure to lubricating oil particles when passed between electrodes maintained under a high electrical potential.

The lubricants are marketed under the trade name "Elektrion," and the additive is known as "Elektrion R." When the motor oils first appeared, their saponification number and emulsifying properties were not especially favourable, but these troubles have now been eliminated. Properties of the additive are :—

Colour	NPA 2/3
Gravity	API 21·5°
Liquid at.	30° F
Visc. S.U. at 210° F.	1000 secs.
Flash point (open)	440° F.
Acid no.	1
Saponification no.	90
Conradson carbon	0·4%
Ash	nil

It is completely soluble in petroleum lubricants. The additive is used in proportions of 5/15% of the total blend and, in addition to increasing the viscosity of the oil with which it is blended, increases the viscosity index and oiliness and reduces pour point and sludge formation. Viscosity and viscosity index curves of blends of additive in light, medium and heavy oils of varying viscosity index are shown. 10% of the additive has at least the same effect as 30% of bright stock of 150 secs. viscosity at 210° F. R. A. E.

810. Lubricating Oil Measurement. E. Padelt. *Oel und Kohle*, 1937, **13**, 175–179.—Modern equipment is described for measuring viscous oils and for blending petrol–oil mixtures. Pumps, etc., are expensive, but without them it is impossible for garages to deliver accurately. P. G. H.

811. Tractor Performance in Theory and Practice. S. J. Wright and E. B. Black. Pre-Print from the Second Conference on Mechanized Farming. Oxford. January 1937.—It is pointed out that the correct use of a tractor depends on economical loading and efficient maintenance. The authors have summarized results obtained by an examination of 20 different tractors working in various parts of the country. In each case the H.P. which was actually being developed on the work in hand was measured. It was found that on the average the tractors were working at only about 72% of their rated load, although the measurements were taken during the busy autumn cultivating season, and in every case heavy work—*i.e.*, ploughing, cultivating, etc.—was being done. The evidence suggested that, in general, even under such conditions, tractors are under-loaded, and that they might on average be made to do about 40% more work in a given time.

In regard to maintenance, it is stated that the main work in connection with tractor repairs arises from faulty lubrication in one form or another. A main source of trouble is excessive dilution of the crank-case oil, owing to the fact that practically every tractor engine is allowed to run much colder than it should.

Results are given of two 24-hour tests, at approximately ¾ rated load on a tractor. In one case the cooling-water temperature was not controlled, so that it averaged about 60° C. over the whole test, and in the second test the water temperature was thermostatically controlled at 87° C. In the first case a dilution of 25% was attained, as opposed to a dilution of 10¼% in the second. The viscosity of the fresh oil, which was

225 seconds Redwood No. 1 at 140° F., was reduced to 86 seconds and 154 seconds, respectively.

It is concluded that all tractors should be loaded as fully as possible, and all steps taken to avoid dilution. To this end it is recommended that a distant reading-dial thermometer should be fitted, and also a radiator blind, so that the cooling water can be maintained at a temperature of about 90° C. W. E. J. B.

812. Patents on Lubricating Oil. British Celanese Ltd. E.P. 461,715, 23.2.37. Lubricating composition prepared from a mineral or vegetable oil, an emulsifying agent and water in which is incorporated methyl stearate (2–10% by wt. of the oil).

Steel Bros. & Co. and S. S. Batnager. E.P. 461,813, 19.2.37. Refining of lubricating oil, diesel oil or kerosine fractions of a crude oil by extraction with glacial acetic acid.

Standard Oil Development Co. E.P. 461,853, 25.2.37. Preparation of fatty oil polymers by polymerizing rapeseed oil diluted with ethylene dichloride at 100° C. with BF_3 using a Friedel Craft type of catalyst.

Edeleanu Gesell. E.P. 462,198, 4.3.37. Solvent extraction of lubricating oil using liquid SO_2, phenol, nitrobenzene, etc.

N.V. de Bat. Petr. Mij. and P. J. Roelfsema. E.P. 462,630, 12.3.37. Refining of lubricating oils, kerosine or motor spirit containing sulphur compounds by rectifying the fraction with a selective solvent, *e.g.*, furfural, aniline, ethylene diamine, etc.

N.V. de Bat. Petr. Mij. E.P. 463,388, 30.3.37. Improvement of lubricating oils by the addition of oxidation products or acids obtained by polymerization or condensation of unsaturated hydrocarbons of low molecular weight.

S. W. Ferris. U.S.P. 2,072,104, 2.3.37. Fractional extraction of lubricating oil using an aliphatic chlorhydrin.

A. J. van Peski. U.S.P. 2,073,080, 9.3.37. Lowering of the pour point of lubricating oils by incorporating them with a small quantity of an alkylated, highly condensed cyclic hydrocarbon having high-molecular paraffin side-chains and nuclei containing more than three aromatic or hydrogenated rings.

G. M. Pfau, D. C. Bolin and E. W. Zublin. U.S.P. 2,073,253, 9.3.37. Process of acid-treating lubricating oils.

R. J. Dearborn and W. P. Gee. U.S.P. 2,074,254, 16.3.37. Solvent refining of lubricating oil using furfural and acetone.

L. A. Clarke. U.S.P. 2,075,268, 30.3.37. Solvent refining of lubricating oils using phenyl ethylchloracetate or benzyl chloracetate.

L. A. Clarke. U.S.P. 2,075,269, 30.3.37. Solvent refining of lub. oils using chlormethyl or chlorethyl phenyl ether. W. S. E. C.

813. Patents on Wax. J. F. Wait. U.S.P. 2,075,151, 30.3.37. Dewaxing of lub. oils and wax production by mildly oxidizing the oil with an alkali metal at 200–400° C. to increase the viscosity index, removing the oxidized portion and then dewaxing the oil. W. S. E. C.

Asphalt and Bitumen.

814. Asphalts, Bitumens and Pitches. G. Martinenghi. *Olii Min.*, 1937, **31**, 1–7.—Six different methods of classification (all taken from the literature) of asphalts, bitumens and pitches are outlined. The scheme proposed by Marcusson, Richardson and Höfer is considered to be the simplest and most practical. By this method, asphalts, etc., are divided into two main groups: natural and artificial asphalts. The former group is sub-divided into asphalts (properly so called), asphaltites and

asphaltic minerals, whilst the second group contains petroleum residues, various tars and pitches. Mainly from information given in the literature, the compositions and properties of many of these products are surveyed, the information being summarized in tables. A number of references to the literature are given. C. C.

815. Plasticity-Temperature Interval of Roumanian Asphalts. V. Cerchez, E. Arion, and V. Niculescu. *Oel und Kohle*, 1937, **13**, 321–324.—Twenty-two Roumanian asphalts of different grade and origin were tested for Ubbelohde melting point (U), softening point (K.S. and R. & B.) and Hoepfner–Metzger setting point (H. & M.). The latter is the temperature at which a penetration of 0·1 mm. (450 gm./1 minute) is obtained. The plastic range, given by U to H. & M. is regarded as significant in asphalt for road building, and was found to vary from 62·5° C. to 97° C. in the samples under test. The range became wider as the softening point was higher, and could differ in samples of the same K–S softening point but of different origin. P. G. H.

816. Rheological Properties of Asphalts. IV. C. E. Coombs and R. N. Traxler. *J. Applied Physics*, 1937, **8** (4), 291.—The elastic and thixotropic properties of an asphalt were determined in a rotating-cylinder viscometer. When an asphalt is subjected to increasing shearing forces, a "threshold" value is reached above which the apparent viscosity at a certain stress decreases with time until a constant value is reached. If an asphalt is subjected to a shearing stress above the threshold value and the stress is suddenly reduced to a low value, the viscosity will gradually increase, even though the asphalt is being worked constantly. The age-hardening of asphalts is a manifestation of thixotropy, and the effect, which varies greatly with different asphalts, can be overcome by heating or mechanical working.

Using various asphalts, comparison has been made using the Bingham–Stephens alternating stress, the falling coaxial cylinder and the coni-cylindrical rotating viscometers, all used at essentially the same mean shearing stress. Good agreement was found when the asphalts were essentially viscous, but the deviations of the results from the three instruments became greater as the anomalous properties of the asphalt became more pronounced. P. D.

817. Non-Toxic Road Tar. W. G. Adam, F. M. Potter and D. G. Murdoch. *J.S.C.I.*, 1937, **56**, 387–389.—The recent announcement by the British Road Tar Association of the commercial availability of a non-toxic tar ("Brotox"), approved by the Ministry of Agriculture and Fisheries for use in the vicinity of fishing streams, is considered to have rendered interesting a brief account of the development of such a tar.

Experiments, which are described, have shown that the water washings from road tars, particularly those of low viscosity, are definitely injurious to fish. The toxicity of the tars decreases with increased viscosity. Naphthalene, phenols and bases are harmful and the varying symptoms of the effect are given.

The process (B.P. 408,275) in use at Beckton for the production of a commercial product is briefly outlined. T. C. G. T.

818. Road Asphalts Manufactured from Heavy Arkansas Crude. W. M. Carney. *Oil & Gas J.*, 25.3.37, **35** (45), 111.—Following a brief outline of the history of the use of bitumen and of the modern methods of manufacture and applications, a description is given of a vacuum asphalt plant at an Arkansas Refinery, operating on Smackover crude. Reference is also made to the manufacture of asphalt by fluxing harder grades and to the preparation of cutbacks and blown bitumens. C. L. G.

819. Use of Asphalt Mastic for Roofing. Anon. *Chem. Trade J.*, 26.3.37, **100**, 276.—The building Research Special Report No. 25 discusses the composition, properties, functions and methods of application of asphaltic mastic for factory building roofings.

The recommendations given to ensure satisfactory results include (a) *Timber roofs*. Use of adequately seasoned timber; boarding should be well nailed with nails well punched in, and joists stiff and not too widely boarded; the mastic should be isolated from movements in the boarded area by the use of a stout underlayer impregnated, but not coated with bitumen.

(b) *Concrete or hollow tile roofs.* A layer of cement mortar or fine concrete should be laid, with a suitable drainage fall (1 in 80), on the concrete or tiles, allowing 7–10 days for drying before application of the mastic. For inclined surfaces a key should be provided to avoid sagging or creeping.

Actinic or thermal effects on the mastic can be reduced by light coloured surfacings, *e.g.*, lime or whitewash, plain or mixed with tallow, requiring renewal at least annually.

The formulation of explicit specifications for mastics of reasonable permanence cannot be effected without further research, but it would be the safest policy to use only mastics prepared from naturally occurring materials of approved origin.

The report includes notes on a number of tests applied to asphalt roofing mastics and their components. C. L. G.

820. Manufacture of Roofing Felt. J. F. Kesper. *Oel und Kohle*, 1937, **13**, 297–299.—Details are given of a new type of impregnating plant, a feature of which is a "deep pan" bitumen tank. The paper passes vertically through the impregnant. Numerous advantages are claimed for this arrangement as compared with the usual horizontal tank. P. G. H.

Special Products.

821. Petroleum Products in the Electrical Industry. C. Chilvers. *Petr. Times*, 10.4.37, **37** (952), 465.—In this the first of a series of articles the properties of cable oils are dealt with. The ordinary physical tests have a limited application to these oils. Cable manufacturers have evolved their own tests as the result of their experience and specific requirements. Viscosity is important, and should be low enough at the impregnation temperature (about 240° F.) to ensure complete impregnation, and high enough at low temperatures to check undue drainage. In the hollow-core type cable the conductor is wound on a spiral metal tube and is paper-wrapped, impregnated and sheathed. The spiral tube is then filled with a transformer-type oil, viscosity approx. 15 c.s. Expansion tanks are inserted in the cable at suitable intervals. The power factor and resistivity are the most important electrical properties of the oil used in these cables. The power factor, which should be low, increases, and the resistivity, which should be high, decreases with rise in temperature. The dielectric strength is useful chiefly in indicating the relative absence of moisture and foreign matter. Oils vary considerably in their ability to withstand service conditions. Accelerated ageing tests are in use, but are of questionable value. H. G.

822. Petroleum Solvents. Anon. *Chem. Trade J.*, 19.3.37, **100**, 245.—At a meeting of the Northern Branch of the I.P.T., F. N. Harrap discussed the manufacture of solvents from petroleum and their applications in industry.

Recommendations for the most suitable types of spirits for use in the following processes are given :—

Perfume extraction, vegetable oil extraction, bone degreasing, alcohol dehydration, cellulose lacquer and printing-ink manufacture, leather and rubber industries, dry cleaning and paint and varnish industries. C. L. G.

823. Preservation of Wood against Fungi and Insects (with Special Reference to Metallic Naphthenates). H. C. Bryson. *Paint Technology*, Part I, 1936, **1**, 429–431, Part II, 1937, **2**, 17–20, Part III, 1937, **2**, 51–53.—The first part of this paper deals with the attack on wood by fungi of various kinds. The mode of growth of fungi and the effect of their attack are described. The most common of these destructive agents is dry rot.

Preservatives may be divided into two sections : (1) oil soluble, (2) water soluble; the former being generally preferred. Crude petroleum and petroleum distillates have no fungicidal effect, but creosote has several excellent properties. However, it has many disadvantages, fully outlined in the paper.

The naphthenates are at present the most efficient and satisfactory fungicides. Cu is rather better than Zn, but has the disadvantage for some purposes of being green. It is important to select the salts carefully, as some have been found to contain wax or free acid, rendering them unsuitable for the purpose in view.

Treatment of wood with metallic naphthenates in the form of a 20–25% solution in

naphtha, white spirit or other solvent overcomes practically every disadvantage associated with creosote.

Instructions are given for the prevention of rot. It is recommended that since the Cu salt is soluble in alcohol, such a solution should be used, as in this way even wet timber can be impregnated.

After applying a metallic naphthenate two or three days should elapse before the wood is painted.

Turning to insect pests, the best known, although not the most deadly, is the death-watch beetle. This prefers large masses of wood, and its elimination is very difficult. The finest remedy so far known is *ortho*dichlorbenzene combined in one solution with Zn naphthenate and applied annually for 2 or 3 years, or even longer.

It is important that only correctly processed soaps, in which the metal is properly combined with the acid, should be used, and two mixtures are recommended: (1) *ortho*dichlorobenzene 1 lb., Zn naphthenate 1¼ lb., naphtha up to 1 gal.; (2) α-monochloronaphthalene ½ lb., Zn naphthenate 1¼ lb., naphtha up to 1 gallon.

The furniture beetle's attacks can be treated with similar solutions.

The Powder post beetle is the most serious insect pest for wood, and the most effective permanent control measure is to treat the timber with a solution of Zn naphthenate 2½ lb. naphtha up to 1 gallon.

Cu naphthenate appears to be the best insecticide for use against white ants or termites, and is used as a solution (2½ lb.) in naphtha, up to 1 gallon.

The depredations of other types of insects are described and preventive measures outlined. D. L. S.

824. Patents on Special Products. E. I. Du Pont de Nemours & Co. E.P. 463,055, 19.3.37. Manufacture of platinum catalysts.

Univ. Oil Products Co. and A. L. Mond. E.P. 463,272, 25.3.37. Preparation of catalyst comprising a calcined mixture of phosphoric acid and a solid adsorbent.

N.V. de Bataafsche Petroleum Mij. E.P. 463,244, 24.3.37. Production of olefines containing 3–5 carbon atoms from gaseous distillate of low aromatic content.

N.V. de Bataafsche Petroleum Mij. E.P. 463,282, 25.3.37. Production of alkenes or their derivatives from cracked hydrocarbon mixtures.

E. I. Du Pont de Nemours & Co., J. A. Nieuwland and F. J. Sowa. E.P. 463,545, 30.3.37. Esterification of organic acids, *e.g.* acetic, benzoic acids, by treating the corresponding alcohol or unsaturated hydrocarbon in the presence of dihydroxy-fluoboric acid or its addition compound with BF_3.

G. W. Johnson. E.P. 463,569, 2.4.37. Production of unsaturated hydrocarbons by heating resin alcohols to 100–300° C., and under reduced pressure if desired, in the presence of a substance which promotes the splitting of water. W. S. E. C.

Detonation and Engines.

825. Control of Combustion in I.C. Engines. W. Ostwald. *Ö.P.I. Publication No.* 6, 1937.—Maximum efficiency of combustion is attained by approximation to the Carnot cycle as a limiting case, but only under conditions of small load. Conversely, high load motors may be attended by waste of heat energy. Owing to the varying cost of fuels, maximum heat efficiency is not always of supreme importance. In practice a compromise is always sought. The course followed by internal combustion may be influenced by (1) the manner of introducing fuel/air mixture into the cylinder, (2) the chemical nature of the combustion, (3) walls of the combustion chamber and their nature, (4) the periodical change in volume of combustion space occasioned by the usual crank system. The control of combustion, particularly with reference to the above factors, is stated to offer possibilities for future improvements. A number of examples of developments of this kind are described. P. G. H.

826. Damping Influences in Torsional Oscillation. J. F. Shannon. *Proc. I. Mech. E.*, 1935, **131**, 387–436.—Describes an investigation of the damping influences occurring in multicrank engines when in a state of torsional oscillation. The major part of the experimental work was carried out on a four-cylinder petrol engine, and a Geiger torsiograph was used to examine conditions of resonance. Extreme methods of lubrication were adopted, and the outstanding influence of lubrication in the control of amplitude at resonance is demonstrated. For the engine dealt with, the principal source of damping is traced to the main bearing.

The dissipation of energy in an oil film, due to journal vibration, is examined analytically, and expressed in terms of journal displacement. From an investigation of the journal displacements caused by crankshaft oscillation, it is found that practically all the input energy of vibration could be accounted for in this manner, thus confirming the experimental observations. The results are finally reduced to an overall non-dimensional factor which is practically constant for the range of frequencies investigated.

Results from a number of multicrank engines on which further experiments had been carried out were available, and these, together with other published data, are also reduced to this simple non-dimensional form. The value of the factor is not constant for the different engine systems, but appears to be correlated to the elastic curve form at the engine, and an average curve taken on this basis is presented as a guide in design. W. W.

827. Cathode-Ray Oscillograph Applications. R. R. Batcher. *Instruments*, 1937, **10** (4), 103.—The applications of cathode-ray oscillographs to measurement of torsional distortion in shafts, position indicators, radio direction finders, light modulators, and the measurement of sounds and vibrations are briefly described. P. D.

828. Recent Developments in Hydraulic Couplings. H. Sinclair. *Proc. I. Mech. E.*, 1935, **130**, 75–157.—The use of hydraulic couplings in practically all fields of engineering has increased rapidly during the last few years. The paper traces the history of the Vulcan-Sinclair hydraulic coupling, which is of the turbo or hydro-kinetic type, from the days of its inception up to the present time, and gives details of other designs of the displacement or hydro-static types that have been developed, and the principles on which they operate. The main advantages of the turbo design are enumerated, and considerable test data are given, with particular reference to the Vulcan coupling, which, in theory, is the forerunner of the Vulcan–Sinclair designs. Advantage is taken to explain the difference between fluid couplings and torque converters, concerning which a good deal of confusion exists.

The difference between the various types of Vulcan–Sinclair hydraulic couplings and the improvements that have been effected in design during recent years are described in detail. The paper deals comprehensively with numerous applications of the different types of couplings covering both the industrial and automotive fields. The difficulties, and their cures, which have arisen in connection with a number of applications are given prominence. A section deals with change-speed gear-boxes arranged in conjunction with hydraulic couplings for use in diesel traction. W. W.

Coal and Shale.

829. Phenolic and Other Constituents of Aqueous Liquors from Coal Carbonization. G. T. Morgan and A. E. J. Pettet. *J.S.C.I.*, 1937, **56**, 109T–114T.—The paper constitutes part of a research into the phenolic substances obtained in the carbonization of coal. Carbonization of dry coal yields about 8 gallons of water per ton, and this may increase to 60 gallons per ton if steam is used in the process.

Liquors obtained from several plants operating on a variety of coals and under various conditions have been analysed, and these analyses are tabulated. The phenolic content of the liquors appears to be roughly proportional to the oxygen content of the coal.

Phenols, cresols, catechol, homo- and *iso*homo-catechol, resorcinol and quinol are in the liquors from the carbonization of coal at 625° C. in the Fuel Research Board's

retorts, and also in those from carbonization at 600° C. in production of "Coalite." Phenol has been isolated in the liquors from carbonization at all temperatures even as low as 450° C. Low-temperature carbonization produces up to 1·7 grm. catechol per litre of liquor; at 1200° C. there is scarcely any catechol, and the liquor from horizontal retorts at 1350° C. contained no polyhydric phenols.

A process is outlined for the isolation of catechol from concentrated aqueous liquors from low-temperature carbonization. T. C. G. T.

830. Patents on Coal. Gewerkschaft Mathias Stinnes. E.P. 462,478, 10.3.37. Solid and fusible products are obtained from coal by extraction under pressure with an organic solvent, *e.g.*, tetrahydronaphthalene in admixture with phenol. W. S. E. C.

Economics and Statistics.

831. Chronicle of the U.S.S.R. Petroleum Industry. I. Ganitzki. *Mon. Petr. Roum.*, 1937, **38**, 631–634.—The article surveys the progress realised in the U.S.S.R. heavy industries, and deals in some detail with that of the petroleum industry. The heavy industries as a whole have surpassed the 1936 plan, the value of their production being 100 billion francs, instead of the 94 billion forecast. Among the few branches of the industry which have failed to fulfil the programme were, coal 95%, petroleum 97% and non-ferrous metals 99%. Among those exceeding their programme were electricity, gold, steel, chemicals, synthetic rubber and tractors.

The production of the petroleum industry was 29·2 million tonnes, of which 1·78 million tonnes were gas. A big feature of the 1936 programme was the decentralization of the big trusts. A list of the trusts and their 1936 production is given. 98% of the drilling programme has been attained, this being 40% greater than in 1935. The number of wells brought into operation is not as high as was hoped. The amount of crude processed was 24,528,000 tonnes, against a planned 25,100,000 tonnes, but the production of spirit at 4,100,000 tonnes is slightly higher than forecast. Lubricating oil production is also rather higher than quota.

The total production of spirit and lamp oil was 9,600,000 tonnes. While the export of gas oil in 1936 was 7% in excess of 1935, spirit exports have decreased by 35%, owing to increased internal consumption. T. C. G. T.

832. Reserves and Deep Drilling in the U.S.A. Anon. *Rev. Petr.*, 20.3.37, (727), 366–367.—Estimated reserves at the end of 1936 were 12,980,000,000 brl., as against 12,992,000,000 at the end of 1935. Although the reserves are greater than 2 years ago, consumption has increased and more discoveries must be made. Kansas, New Mexico, the Rocky Mountain region and Texas have been the areas of increased reserves, whilst other areas have declined. Drilling activity has been greatest in Texas, particularly in S. Texas, whilst Kansas leads in the list of new horizons discovered. California has declined owing to the optimism of previous estimates.

Thanks to geophysical work, deep drilling in prospect wells is quite common in the U.S. and the search for reserves is hopeful. R. O. Y.

BOOK REVIEWS AND BOOKS RECEIVED.

Book Reviews.

DRILLING MUD; ITS MANUFACTURING AND TESTING. By P. Evans, B.A., and A. Reid, M.A., B.Sc. Being Vol. 32 of the *Transactions of the Mining and Geological Institute of India*, Calcutta. 10¼″ × 7″; pp. 263 + xxx. Obtainable from the Institution of Petroleum Technologists, Aldine House, Bedford Street, Strand, London, W.C. 2; price 19*s.* 6*d.* post free; or from The Mining and Geological Institute of India, 27 Chowringhee, Calcutta, India; price 13 rupees or 5 dollars, post free.

There are three drilling systems in regular use in the oil industry: percussion or cable-tool drilling, core drilling and rotary drilling. The rotary drill, of comparatively modern development, is by far the most important, and has enabled the prospector to reach depths of 10,000 and even 12,000 ft. in his search for new supplies of oil; the essential feature of the "rotary" is a long pipe rotating at high speed and carrying on its end a bit of suitable design. In the early days of rotary drilling it was customary to remove the fragments of strata—cuttings, as they are called—by means of a stream of water which passed down the inside of the pipe carrying the bit, through apertures in the drilling bit, and up the annular space between pipe and hole. In wells drilled through clay or shale, the water in circulation became muddy, and indeed might become so viscous as to necessitate addition of fresh water and rejection of a part of the fluid in circulation; it was noticed that this clay-laden water had many advantages over clean water as a circulating fluid and the use of a mixture of clay and water—termed mud-fluid or drilling mud—for rotary drillings is now universally accepted practice.

The increase in depth to which wells have been drilled has brought with it a very great increase in the difficulties of drilling, and within the last few years the need for finding the most suitable clay–water mixture for the conditions encountered has become more generally appreciated. The importance of drilling mud is illustrated by an instance in which over £25,000 were spent on the provision of drilling mud for a single rotary well, and it is evident that the properties of this "mud-fluid" deserve the most careful investigation. The paper by Messrs. Evans and Reid forming volume XXXII of the *Transactions of the Mining and Geological Institute of India* discusses the preparation, and more particularly the testing of rotary drilling mud.

The aim of the writers has been to discuss experimental results obtained in the laboratories of the Burmah Oil Co., and to review the wide literature to which they have had to refer.

Drilling mud is usually made in a central plant which supplies a number of wells; methods of manufacture are based either on churning or jetting, or preferably a combination of these. A method of jetting often termed hydraulicing is useful in mixing up soft clays and shales; a high-pressure jet of water is forced on the clay face, and the resulting thin mud re-cycled until it reaches the desired consistency. In hopper mixers there is a horizontal jet below an inverted cone, and ground clay or shale is fed into the mouth of the hopper, sucked down by the vacuum created by the jet, and so mixed intimately with the water.

The mud plant must also deal with the reclamation of used mud, which is especially necessary where the cost of fresh mud is high. Removal of sand and cuttings brought up during drilling is achieved by a settling ditch along which the mud flows, by passage over vibrating screens, or by centrifugal means. The vibrating screen is also useful in removing gas which becomes trapped in the mud when drilling through gas sands, and tends to remain there with remarkable pertinacity. The simpler means of cleaning the mud are provided at all wells, and the more elaborate ones at important wells and in the central mud plant.

To obtain the best results, in both manufacture and use, adequate testing is required, and this subject is discussed at length in the paper.

Mud should be regularly weighed while in use, in order to ensure that sufficient hydrostatic pressure is maintained at the bottom of the well, and also because, when the properties of a mud are sufficiently well known, it is possible to specify a range of weight within which the mud is likely to have the desired characteristics. The weight (or more accurately, specific gravity) may be controlled by varying the proportions of solid and liquid or by varying the density of the liquid—*e.g.* by using brine instead of water. To obtain muds of high specific gravity, barytes or hæmatite is added.

Perhaps the most important test on a mud, and the one least understood, is the measurement of viscosity. Drilling mud in flow does not behave in the same fashion as a simple liquid such as water or oil. Whereas the smallest force applied to a true liquid in a long, narrow tube will cause a slow flow, this is not so with drilling mud, which possesses a "yield value" which must be overcome before flow takes place. The resistance to flow depends not only on this initial resistance, but also on the "mobility" of the mud, and consequently, in place of a single number to represent viscosity, it is necessary to employ the two expressions "yield value" and "mobility." This type of flow is termed "plastic flow," and the subject receives detailed treatment in the paper. It is pointed out that because the majority of writers on mud-fluid have not appreciated the need for describing the flow of mud in terms of yield value and mobility, much published work is difficult to interpret.

The paper then goes on to discuss viscometers used for measurements on mud-fluids, and describes those employed in America, India and elsewhere. For routine work in Burma and India a paddle viscometer has been extensively used; in this the force needed to rotate a small paddle immersed in the mud is measured by placing weights on a scale-pan. Operating difficulties in the viscometers discussed are dealt with in brief, and frequent references are made to the relevant literature. Various factors affecting viscosity are illustrated by reference to actual examples of measurements by the authors and their colleagues.

The problems of the flow of mud in the circulating system of a well have received but little attention in the past, and an attempt is made to indicate lines on which it might be possible to relate the physical properties of the mud to the pressures needed in the pumps which force the mud through the circulating system of the well. As the mud has to travel at high velocities for perhaps two or three miles in a very restricted space, the pump pressures required may be extremely high.

The next subject to be discussed is thixotropy, a phenomenon of fairly common occurrence, but one which has not received the attention its importance deserves. Thixotropy refers to the property whereby certain muds will gradually set to a jelly-like mass, but will return to a mobile liquid if agitated, and again set to a jelly if allowed to remain undisturbed. The change from liquid to jelly and jelly to liquid may take place almost indefinitely. There has been considerable confusion in the literature between the variable viscosity shown in plastic flow and the changes in viscosity produced as a thixotropic mud sets to a jelly. Measurement of this property of thixotropy is complicated, and so far the control of the phenomenon has not been satisfactorily achieved, despite the importance which would attach thereto.

A fairly full treatment is accorded to the measurement of acidity and alkalinity ("pH"). In view of the manifold applications of pH in industry, it is to be expected that pH of muds may be important in a number of respects; but so far experimental work is slight, and not entirely satisfactory.

Other tests made on mud are more briefly discussed; salinity tests—to determine the amount of salt in the mud—aid in the detection of small inflows of saline water from the formations drilled through; stability tests are very important, as unstable muds may lead to almost endless troubles in drilling. The amount of sand carried by a mud should be a minimum, in order to reduce wear and tear on pump parts, and frequent checks on the sand content are recommended. The size of the particles composing the mud, the colloid content, the plastering power, the plasticity and various other properties receive consideration. Plastering power is an important, although little-understood property; one of the important functions of the mud is to build up a sheath of clay on the surface of the formations drilled through.

There are numerous illustrations in the text, emphasis being laid on the graphical

presentation of experimental results. The references are drawn from a very wide range, and the detailed lists of contents and the full indexes make it easy to turn to any of the subjects dealt with.

The paper provides an example of the way in which what appear to be mere technical details of an industry may give rise to prolonged scientific investigations, and also an example of the application of apparently quite academic inquiries to matters of industrial importance.

METALLIC CORROSION, PASSIVITY AND PROTECTION. By Ulick R. Evans. Pp. xxiii + 682. Index 683–720. 1937. Edward Arnold & Co., 41 and 43 Maddox Street, W. 1. Price 45*s.* net.

Given such a comprehensive title, the reader will no doubt anticipate either an encyclopædia or a disappointment. We can assure him at the outset that he will receive neither, but, on the contrary, a well-planned volume, wide in scope but not diffuse, written in a thoroughly readable way, unbiassed in its statements, and yet critical where criticism appears to be justified.

The accumulation of researches on these subjects during the past decade has been so enormous that Dr. Evans's task has been a very formidable one—his author index contains 1700 names—but there is no doubt whatever that he has mastered it with most admirable thoroughness.

The method of presentation, while not entirely novel, is sufficiently unusual to stimulate attention and interest. Each chapter is divided into three sections, (A) The Scientific Basis, (B) The Practical Aspect, and (C) The Quantitative Aspect, which includes graphs, mathematical expressions and discussion of principles and hypotheses.

The author's foreword warns us that the first is designed for the pure scientist (possibly even for the pure chemist), and the second for the practical man (either an engineer of unqualified purity or a manufacturing chemist who needs no other adjective). Section (C), in contradistinction, is designed for those who can think for themselves. In one case a Section (D) has been provided by the National Physical Laboratory staff, who, we infer, are regarded as in a distinctive category to the foregoing. The scheme is a good one, and succeeds admirably, for every reader will be able to study with interest and advantage at least some part of every chapter.

The contents table shows the wide scope of the book. It deals with corrosion by air (hot and cold), by stagnant and by flowing liquids, the effects of "impurities" both accidental and deliberate, of mechanical and electrical stresses, and of crevices and points of contact with non-conductors or dissimilar metals. This covers the first twelve chapters. Two chapters are devoted to protection by metallic and non-metallic films respectively, and one to conditions and methods of testing, with an appendix on the measurement of film thicknesses.

The subject and name indexes are efficiently compiled, and the bibliography contains references to 323 different journals, an excellent testimonial to the Cambridge card-indexes.

Dr. Evans's book can be wholeheartedly recommended to pure scientists and to practical men alike. F. B. T.

AIR CONDITIONING—INSULATION. By J. Ralph Dalzell and James McKinney. Pp. viii + 301. 135 figures, 72 tables and 3 photographs. 1937. American Technical Society, Chicago.

This book treats of the principles and applications of insulation as a means of (1) retarding heat losses and gains through structural parts of buildings; (2) guarding against fire; (3) controlling sound; (4) preventing vibration; (5) protecting buildings against termites; (6) protecting all mechanical parts against heat losses and freezing; and (7) preventing condensation.

The authors assume that their readers are familiar with simple mathematics, architectural details, designs of ducts and general heating and air-conditioning principles. Insulation, it is claimed, has reached the rank of an individual science, as being the means of making the arts of heating and air-conditioning buildings both sound and economic. Ample insulation is essential if a residence or other structure is

to be properly air-conditioned, otherwise it would be too expensive, because the heat loss during winter and the heat gain during summer would make the cost and maintenance of the original apparatus prohibitive.

The volume consists of eight chapters: Chapters I and II discuss the history of insulation with a physical explanation relative to the general phases of insulation. Chapters III and IV are a general explanation of typical kinds of insulation and where each kind may be used in ordinary structures, including mechanical parts. Chapter V explains theory and practice relative to heat losses with important items of coefficients. Chapter VI gives an explanation of basic principles as to calculation of heat losses (heat load) and heat gain (cooling load). Chapter VII discusses practical methods of insulating and protecting buildings, including mechanical parts, against loss by fire, condensation, etc. Chapter VIII gives typical examples of designing and applying insulation to typical structures, illustrating calculations in terms of B.Th.U.'s, full saving incurred by insulation and other benefits of the practice, *e.g.*, calculations are made on the heat loss for a 210-day heating season in an uninsulated house compared with (*a*) a house with minimum insulation, (*b*) a house with intermediate insulation, (*c*) a house with thorough insulation, showing that on (*a*) the saving in fuel is 30% per annum on the installation investment and pays for it in 3½ seasons, on (*b*) is 25% per annum and pays for it in four heating seasons, and on (*c*) is 22% on investment and pays for it in 4¾ heating seasons, and that the reduced radiation required is 31% in (*a*), 38% in (*b*), and 42% in (*c*).

The book is written primarily for people living in North America, where radiator heating and air conditioning are more universal than in older countries, but it should be a volume of academic interest to students of insulation, heating of buildings and air conditioning and of particular interest to the builders of prospective large buildings, hotels, large blocks of flats and the more expensive type of house, but it is not apparent that insulation could be added on thorough lines and economically to any building already constructed. It would seem likely to be of greater interest to such concerns as were undertaking large developments in countries having climates of extremes of cold and/or heat, where it would be necessary that the indoors parts of buildings should be maintained at a fairly even temperature throughout the year, either for the sake of the health of the workers or for the adequate working of the industrial processes to be undertaken.

The volume is profusely and very clearly illustrated, concluding with a concise index, and attached to the back cover is a psychometric chart with directions for use.

B. F. N. M.

Books Received.

U.S. Geological Survey:

BULL. 878. ANALYSES OF ROCKS AND MINERALS FROM THE LABORATORY OF THE UNITED STATES GEOLOGICAL SURVEY, 1914–36. R. C. Wells. Pp. x + 126. Index pp. 127–134. 1937. Superintendent of Documents, Washington, D.C. 15 cents.

BULL. 880-A. THE MINERAL INDUSTRY OF ALASKA IN 1935. P. S. Smith. Pp. 88. Index pp. 89–95. 1937. Superintendent of Documents, Washington, D.C. 20 cents.

This report gives data concerning the mineral production of Alaska in 1935 and includes reference to the imports of petroleum to Alaska from the United States during the years 1905–35. In 1935 the imports of heavy oils almost doubled those of the previous year and the imports of gasoline increased over 1,000,000 gallons.

Uganda Protectorate:

ANNUAL REPORT OF THE GEOLOGICAL SURVEY DEPARTMENT FOR THE YEAR ENDED DECEMBER 31ST, 1936. Pp. 27 + provisional geological map of Uganda. Geological Survey Office, Entebbe, Uganda. Shs. 3.

IMPERIAL INSTITUTE MINERAL RESOURCES DEPARTMENT. REPORTS ON THE MINERAL INDUSTRY OF THE BRITISH EMPIRE AND FOREIGN COUNTRIES. BARIUM MINERALS (Second Edition). J. Simpson. Pp. 84. 1937. Imperial Institute, London. 2*s*.

This book deals with the uses and resources of barytes and witherite in the Empire and foreign countries, as well as with the world trade in these minerals. Apart from the paint trade, which consumes the most important quantities of barium minerals, barytes finds employment in the heavy mud used for preventing outbursts of oil and gas when drilling oil wells.

S.A.E. HANDBOOK. 1937 Edition. Pp. xlii + 756. Society of Automotive Engineers, Inc. 29 West 39 Street, New York City.

LUBRICATING OILS. TRANSACTIONS OF THE FIRST ALL-UNION SCIENTIFIC AND TECHNICAL CONFERENCE ON THE PRODUCTION AND CONSUMPTION OF LUBRICATING OILS. N.E. Chernoshokova. Pp. 576. 1936. All-Union Scientific and Technical Society of Naphthologists, Moscow.

This book, which is entirely in Russian, contains the following sections: (I) Resources of Raw Materials; (II) Production and Purification; (III) Properties of Oils; (IV) Appendix. Resolutions of the All-Union Scientific and Technical Conference on the Production of Oils (Baku, 25.xi–1.xii.1934).

THE SHAPE OF ROAD AGGREGATE AND ITS MEASUREMENT. A. H. D. Markwick. Road Research Bulletin No. 2. Pp. 12. H.M. Stationery Office, London, 1936. 6*d*. net.

MAN IN A CHEMICAL WORLD. A. Cressy Morrison. Pp. xi + 291. Illustrated Text. Charles Scribners Sons. New York and London. $3.00.

This book, an outgrowth of the celebration of the three hundredth anniversary of the birth of the Chemical Industry in the United States, is written in popular style for the man-in-the-street, with the object of impressing him with the enormous rôle played by the Chemical Industry in supplying his everyday needs. Apart from the contribution to health, food supplies, transport, defence, and the various necessities and luxuries of modern civilization, the activities of the Chemical Industry are shown to mitigate the potential causes of international conflict, by increasing the capacity of countries to support dense populations and to avoid monopolies through substitution of materials and the creation of synthetic products.

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Geology.

833. Variations in the Chemical Composition of the Oil and Gas Bearing Limestone at the Sioux City Well, Turner Valley, Alberta. W. P. Campbell. *Can. Inst. Min. & Met. Bull.*, Jan. 1937 (297), 23–34.—The investigation of the Sioux City Well had for its main object the composition of a limestone formation which had been penetrated during drilling to a depth of over 1700 ft., and from which shows of gas and oil were reported.

The results of the inquiry, given entirely from a chemist's point of view, show that the first 400 ft. of the limestone (from 4400 to 4800 ft.) has a high magnesium content approaching pure dolomite. Below this depth the limestone consists mainly of calcium carbonate, the magnesium content tending to decrease with depth.

Production was mainly obtained in or near the highly dolomitized zone, at 4450 to 4600 ft., although it was not confined to this zone, as showings of gas and oil were reported at depths where the limestone was proved to be wholly calcium carbonate. Gas and oil, moreover, were reported at ten different depths, in every one of which (excepting 4510 ft.) the silica content is extremely low. This would seem to indicate a relationship between the silica content of the limestone and the presence of gas and oil in this particular well.

Samples of the drill cuttings were taken at intervals of about 10 ft. A table of analyses of these samples and a diagram showing the variations in chemical composition of the limestone accompany the paper. G. S. S.

834. Revision of the Geology of the Southern Alberta Plains. L. S. Russell. *Can. Inst. Min. & Met. Bull.*, March 1937 (299), 185–196.—This paper deals firstly with the general geology of the Southern Alberta Plains and concludes with a section on the oil and gas possibilities.

Stratigraphically, the succession consists of Cambrian, Devonian, Carboniferous, Jurassic, Cretaceous and Tertiary sediments; brief descriptions of the divisions making up these systems are given.

The fundamental structure is anticlinal, with a very decided plunge to the north, forming the well-known Sweetgrass arch. To the west the dip steepens, forming the east limb of the adjacent Alberta syncline.

Although prospecting for oil and gas has so far met with only partial success on the Southern Alberta Plains, the view is held that large accumulations of oil occur beneath this region. Known occurrences include the Ellis–Madison contact zone, the basal zone of the Blairmore–Kootenay, the lower sandy portion of the Alberta Shale, and a small amount is obtained from the Lower Milk River beds. From an accompanying structural map it appears that the Sweetgrass arch is a huge funnel up which oil and gas have migrated until stopped by reverse dips such as those on the south side of the Kevin–Sunburst dome. Thus, in the absence of a northward plunge to the fold, oil and gas might have accumulated on a large scale in Alberta.

A further type of accumulation occurs along the margin of a lens of pervious rock, several lenticular sandstone beds being present in South Alberta. Excepting, however, the Medicine Hat gas sand, they are not suitable for this form of accumulation, owing to the direction of thinning being towards the N.E., which is also the direction of dip. G. S. S.

835. Some Geological Problems of Central Saskatchewan. F. H. Edmunds. *Can. Inst. Min. & Met. Bull.*, Jan. 1937 (297), 45–58.—This article describes the stratigraphy and structure of the area, together with the results of test wells. It concludes with a brief discussion of geological factors relating to oil and gas deposits.

G. S. S.

836. Southern California as a Structural Type. R. D. Reed. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 549–559.—In a recent paper by J. S. Holliston and the author, the latter refers to their work on the Cretaceous and Cenozoic in the Southern California province. The conclusion then reached was that this province consisted of sub-provinces of distinct kinds, each of which had been depressed, uplifted, folded and faulted contemporaneously.

The possibility is now discussed of recognizing similar sub-provinces with similar successions of events in other folded Tertiary provinces of the world. A comparison of conditions is therefore made with the Malay Archipelago and the Eel River Basin (North California).

Some of the more important points relating to North California are: (1) the oldest fossils (foraminifera) occur in the beds lying on the Mesozoic basement rocks near Cape Mendocino. These organisms belong to the basal Middle Miocene zone, which is the most strongly transgressive horizon in Central and Southern California; (2) the Pliocene contains almost exactly the same zones in the same order as the Pliocene of the Los Angeles basin. Several subzones, however, are omitted in the middle part of the Repetto, their position being marked by a striking disconformity; (3) above the Upper Pico clays and silts (in nearly all respects exactly like those of Southern California) follows a conformable sandy member, like the Saugus. Major folding of the Eel River Tertiary followed the deposition of this member, and renewed subsidence ensued with deposition of Pleistocene sands, etc., with folding of a milder type.

Sketch maps and diagrams are also given comparing both regions with Southern California with regard to structural types, stratigraphy and Tertiary history.

G. S. S.

837. Stratigraphic Relations of the Austin, Taylor and Equivalent Formations in Texas. L. W. Stephenson. U.S. Geol. Surv. Prof. Paper 186 G, 1937, 133–146.—The Austin Chalk in its type area (Travis Co.) has an estimated thickness of 420 ft., and is capable of subdivision into faunal zones. At least five of these are well characterized and easily traceable in the upper part of the formation. In ascending order, the zones are: *Inoceramus undulato-plicatus*, *Gryphæa wratheri*, *Exogyra tigrina*, *Ostrea centerensis* and *Ostrea travisana*, the latter about 10 ft. below the top of the chalk.

The relation of these zones to the top of the chalk indicates the presence of an erosional unconformity separating the Austin from the overlying Taylor beds. The degree of erosion varies from place to place, the maximum occurring in the vicinity of Waco, where the Taylor beds rest directly on the *Inoceramus undulato-plicatus* zone, and the minimum in Fannin and Lamar Counties. Here the top of the Gober tongue of the Austin Chalk is about 200 ft. stratigraphically higher than the top of the type Austin in Travis Co.

At most places the unconformity is marked by a thin phosphatic bed forming the base of the Taylor Marl. This bed is traceable from Lamar Co. (N.E. Texas) eastward to Red River County, and there forms the basal bed of the Annona Chalk which overlies the Brownstone Marl.

The name "Pecan Gap Chalk" is used, by certain other workers, essentially as a faunal zone rather than a lithologic unit, and made to supplant the formational names "Annona Chalk" and "Anacacho limestone." This is not considered justifiable. The formational names have many years' priority, and each of the units is much thicker (several hundred feet) and embraces a much longer time period than the Pecan Gap chalk, which has a thickness of less than 50 ft. G. S. S.

838. General Conditions in the East Texas Field. W. S. Morris. *Oil Weekly*, 31.5.37, **85** (12), 35–42.—This article is one of three comprising a symposium on the East Texas field.

The structure is essentially a gently dipping monocline, oil being produced from the Woodbine sand where it pinches out against the western flank of the Sabine uplift. The sand is effectively sealed by the Austin chalk which overlies it unconformably. It has an average porosity of 25% and a very high permeability; the oil-bearing portion has a maximum thickness of over 100 ft., but averages 47 ft. The geothermal gradient is found to agree with that in the rest of N.E. Texas.

With reference to well-spacing, it is pointed out that many more wells have been drilled than are necessary to drain the sand effectively. The reservoir pressure has

declined from 1620 to 1161 lb. per sq. in., the sharpest declines having corresponded with the highest rates of withdrawal. The present rate of decline is reduced by a strong natural water drive from the west. A few words on production methods conclude the article. A. J. H.

839. The Van Oilfield. R. A. Liddle. *Univ. Texas Bull.*, Jan. 1936, 3601.—Van field, E. Texas, "discovered" in Oct. 1929, has been under unit control since then. Situated in the E. Texas embayment on the crest of a deeply buried and broadly domed salt mass, geology, geophysics and exploratory coring all played their part in its discovery. The regional geology is described and the history of the discovery—the use of the geophysical methods, once an uplift had been suggested by rough surface mapping. In May 1927, a refraction seismic survey was completed, and a copy of the original seismic map given is of great interest. Next, a torsion balance survey revealed the presence of a large low-gravity mass, probably salt, to be coincident with the uplift. The mass had a N.–S. axis modified by N.E.–S.W. faulting; its shape was deduced by a torsion balance profile from Grand Saline salt dome to Van. Next, a magnetic survey again showed a distinct minimum at Van owing to the immense 10-mile-diam. mass of salt, whereas at Haynesville and Grand Saline, although the salt comes within a few hundred feet of the surface, it has a diameter of 1 mile only, and did not show up well. The use of the three geophysical methods shows admirably the advantages and disadvantages of each. Finally, detailed areal and structural mapping, including coring in shallow exploratory wells, was done before the test well was put down in 1929—a remarkably scientific procedure. The history of the exploration of the field is illustrated with a wealth of geophysical and structural maps, which will be of theoretical interest for years to come. Such confidential work has probably not been published before, and is due to the unit control of the field.

The stratigraphy, from the Wilcox at the surface to the U. Comanchean, as deep as has been drilled yet, is described in detail, and excellent structural maps showing fault faces are given on seven of the main horizons. The regional geological significance is discussed, the field being an incipient salt dome. The age of the salt is discussed and left an open question, as is the age of the oil. Woodbine production is the most important, and minor horizons are derived from this by faulting and migration.

Drilling methods, production statistics and oil analyses are described, and pressure decline, water encroachment, proration methods, salt-water analyses and future reserve are discussed.

The book is profusely illustrated with large maps, which are conveniently given in a folder. R. O. Y.

840. Some Organic Constituents of a Recent Sediment from Chincoteague Bay, Virginia. R. C. Wells and E. T. Erickson. U.S. Geol. Surv. Prof. Paper 186 D, 1937, 69–79.—This paper gives an account of the methods of analysis and character of the products isolated from a recent deposit. The sample used in the investigation was obtained from Chincoteague Bay, the bottom of the bay being approximately level and the water essentially coastal sea-water.

The organic content of the sample was approximately 0·7%, and from this a number of different substances were isolated by extraction with solvents and other methods. Alcohol, ammonium hydroxide and sodium hydroxide were the three principal reagents employed.

The chief organic substances found were chlorophyll, sulphur, algin, wax, humic acid complex, fatty acid material, and acid-soluble organic matter. A further subdivision of these groups was made by melting-point and other tests.

Analytical methods of procedure are described in detail, together with the results obtained, which are also tabulated. In addition, a map of the Chincoteague Bay region accompanies the paper. G. S. S.

841. Anahuac Field. Anon. *Rev. Petr.*, 21.5.37 (736), 665.—Anahuac, discovered in Jan. 1935, is one of the most important recent Gulf Coast discoveries. Found by seismograph and torsion balance methods, it covers an area of 7500 acres. With a cover of Pliocene and Miocene age, production is from the Frio sands of Lower Oligocene age. The field is regarded as a very deeply buried salt dome affected by a

series of N.–S., E.–W. and N.E.–S.W. faults. Wells may be drilled to the producing horizon at 7000 ft. in twenty days, at a cost of $27,000, and the reserves of the field are placed at 350,000,000 brls. R. O. Y.

842. Albanian Oil. M. Schwob. *Compt. rend. Geol. Petr.* (*Strasbourg*), 1935–1936, 4–6, 38–42.—Although there are numerous oil indications in the country, commercial production is obtained only in the Devoli Area. The oil is obtained from the Upper Miocene at depths from 400 to 700 metres in a "foundered basin." The field covers an area of at least 6 sq. km. on the left bank of the river, and about 40 wells have been drilled, the productive capacity being about 300 tons per day. An analysis of the oil is given. Oil has also been found at Pathos on a shallow structure in the Miocene, but the oil is very heavy and highly sulphurous. A. J. H.

843. Oil in Brazil. Anon. *Rev. Petr.*, 4.6.37 (738), 721.—Exploratory drilling for oil in Brazil began in 1918 in the states of Sao-Paulo, Parana and Para, 63 wells being drilled. Recently new wells have been started in the Alagoas (E. Brazil) and Acre regions by the Federal Geological Service. While awaiting the results of these wells, it is stated that although seepages and oil impregnations exist, as yet no productive nappe has been discovered. Private enterprise is responsible for search also in Alagoas and Riacho Doce, where gas has been found. The policy of the Geological service has been severely criticized lately, on the grounds that they have been unwilling to drill wells and have prevented private enterprise from undertaking prospecting.
R. O. Y.

844. Contribution to the Knowledge of the Liassic Stratigraphy in the South of Mendoza Province. K. E. Boehm. *Bol. Inform. Petroleras* (*B.A.*), March 1937, **14** (151), 21–31.—New outcrops discovered in the area between the Rio Atuel and the Rio Grande have added to the knowledge of the Liassic stratigraphy between Aconcagua and Patagonia. They are also of palæo-geographical interest in forming a link between the outcrops of the two districts.

The Lias deposits are described in three districts, these being the La Brea uplands, Macizo del Chiguiu, and Cañada Colorado. In the La Brea region the outcropping rocks are lower and middle Lias in age, and consist of coarse sandstones and conglomerates, arkosic sandstones and sandy limestones. Lithological changes and the occurrence of fossils make possible a subdivision of the complex; the lower horizons (green sandstones and calcareous sandstones) are Sinemurian, and the upper beds (sandy limestones and black bituminous limestones) are Charmouthian. Correlation can also be made with other areas. In the Macizo del Chiguiu area elucidation of the stratigraphy is made difficult by structural complications and the scarcity of fossils. However, most of the beds are Liassic; the lower part is of a shallow water, and the upper part of a deep-water facies. In the La Brea district the Lias is wholly shallow water, so the shoreline of the Lias sea must have been farther to the east than was formerly thought. In the Cañada Colorado the lack of fossils and strong metamorphism make correlation difficult. The Lias beds are unconformably overlain by the Dogger, and Gerth referred them to the upper Lias, but the author prefers to place them in the lower Lias. Bituminous siliceous limestones would then link the sandy bituminous limestones of La Brea with the bituminous paper-shales in the Chiguiu region.
A. J. H.

845. Geological Conditions of the Search for Oil in Morocco. J. Lacoste. *Compt. rend. Geol. Petr.* (*Strasbourg*), 1935–1936, 4–6, 23–37.—This article is chiefly concerned with past exploratory work conducted in Morocco. Numerous oil indications are known in the southern part and the interior of the Riff country, and in the Atlas mountains; these are briefly described. The Riff foreland is generally thought to consist of a big nappe of Trias and Nummulitic formations resting on the Miocene. Two stratigraphic series have been worked out in neighbouring areas and are tabulated. Encouraging results were obtained from drilling at Tselfat, Si Moussat and Ain Hamra. The deposit at Tselfat later proved to cover only a small area (about 50 ha.); search was then made for accumulations on analogous folds, some oil being found as a result.

The origin of the oil is discussed, several possible source rocks being mentioned. The author is of the opinion that the Lias limestones are responsible for most of the oil.
A. J. H.

846. Prospective Oil Territory in Morocco. G. Petunnikov. *Petr. Z.*, 1.4.37, **33** (13), 17–19.—A résumé is given of the mining laws in Independent Morocco in so far as they affect prospecting. In French Morocco the French mining laws hold.

Prospective oil territory in Independent Morocco can be divided into four zones. The first zone, in which seepages of fluid oil occur, is situated in the S.W. corner of the country and is some 35 km. in length. The second zone lies to the south of the port of Sanjurjo (Sanhurho). Geological conditions in this zone are very complicated. Oil shows are found in the tributaries of the river Kert and elsewhere in sands and marls. The third zone is the longest and extends in an E.–W. direction, somewhat south of the second. It is more or less parallel to the area being developed in French Morocco, and as yet has been little investigated. The fourth zone is a small area west of Melilla.
S. E. C.

847. Bituminous Deposits of Palestine and Syria. R. Seiden. *Petr. Times*, 29.5.37, **37** (959), 703–705.—Recent investigations of the bitumiuous Palestinian limestone have been disappointing, finding it to be inferior to the better-known asphaltic rocks. Past uses of some of the deposits are mentioned, and future uses suggested. It is possible that richer deposits may be found at greater depths.

"Syrian" asphalt, found floating in the Dead Sea, is believed to be derived from an asphaltic dolomitic limestone in Wadi el Muhauwat, having been carried to the sea in a semi-molten state by hot springs. It is black, brilliant, and very hard, and analysis shows it to be very pure. The writer regards the asphalt as evidence supporting the existence of oil in Palestine, and as further proof of the Engler–Höfer hypothesis that asphalt is an oxidation–polymerization–evaporation product of petroleum.
A. J. H.

848. Stratigraphy and Faunal History of the Austrian Upper Tertiary. R. Sieber. *Petr. Z.*, 1.4.37, **33** (13), 1–8; 5.5.37, **33** (18), 17–26.—This work is the commencement of a series of investigations on the stratigraphy and faunal history of the upper Tertiary in Austria. It deals in particular with the differences between the Lower Austrian lower and middle Miocene, the subdivision and fauna of the middle Miocene, and the stratigraphical value of certain gastropod families. There is a very sharp boundary between the Burdigalian and the Helvetian, it being marked by the disappearance of the old fauna and the coming in of a new. This is in agreement with the character of the Helvetian transgression, and the influence of the migration of species from the Indo-Malayan and the North American Miocene is traced. Each stage of the middle Miocene has its characteristic species. The paper is illustrated by photographs of characteristic gastropods.
S. E. C.

849. France's Search. P. Charrin. *Oil Weekly*, 31.5.37, **85** (12), 62–64.—This article describes exploration for oil carried out in France. In Alsace there is the Pechelbronn field, and farther south showings have been encountered in wells drilled near Hirtzbach. In the Jura mountains, gas has been found in several wells drilled in the vicinity of Vaux-en-Bugey, and some oil showings have been found in the Molasse (Miocene). Some oil has been produced at Gabian (Languedoc) from Triassic formations. The structure is not known definitely, but a test well is being drilled on the next known structure to the south. Exploration in Limagne has been disappointing, although early indications were good. In the Landes and Pyrenees, numerous seepages attracted drilling, but no production has resulted. A few wells have been drilled in the Alps, and oil shows were reported in one of them. The total footage drilled in each district is given, and it is suggested that it is too small to preclude the possibilities of oil production in France elsewhere than at Pechelbronn.
A. J. H.

850. Will a Deep Well in the Paris Basin Strike Oil? C. Finaton. *Rev. Petr.*, 4.6.37, (738), 724–725.—Now that deep drilling is common, the time seems opportune for a deep test, 2000–2500 m., in the Paris Basin. At present deep wells, as water wells go,

tap the water supplies of the Tertiary and Upper Cretaceous at depths up to 800 m. In the proposed test the Posidonomya bituminous shales of Lower Jurassic age are regarded as the first good chance of oil. The Trias would be expected at about 2000 m., and might, in the author's opinion, give oil, and artesian waters would be expected in the lower part. Below the Trias the older beds cannot be predicted, but the Carboniferous may be met or the Silurian, which might give oil. In the author's opinion the well should be carried down to the basal complex. Even if no oil is met with, coal and iron ore deposits and water should be found. The minerals might be exploited on the edges of the basin, while Paris is badly off for water supplies at the present time. R. O. Y.

851. Comparative Studies of the German and Polish Oilfields. Z. and T. v. Bielski. *Petr. Z.*, 5.5.37, **33** (18), 1–16; 12.5.37, **33** (19), 1–8.—This paper is divided into four parts. In the first part the historical development of the German and Polish fields is briefly reviewed. Then follows a short sketch of their geological features. The third part is devoted mainly to a description of German drilling and production equipment, little being said of Polish methods. Finally the legal aspects and organization in both countries are compared. S. E. C.

852. Transgressions in the Upper Senonian of Hanover and the Uplift of the Hänigsen–Wathlingen and Wienhausen–Sandlingen Salt-domes. L. Riedel. *Z. Deutsch. Geol. Gesel.*, 1937, **89** (1), 19–44.—The presence of a transgression in the Senonian beds of Hanover had long been known, but data were lacking as to its exact age. As a result of the present drilling activities many cores have been obtained which throw new light on the problem. There is a transgression of considerable extent between the Quadraten and Mucronaten zones of the Senonian, and another, somewhat younger, in the lower part of the middle Mucronaten zone. As yet the evidence is insufficient to show conclusively whether these transgressions have a regional significance, since it is obtained from zones of uplift around the salt masses.

An important phase in the uplift of the salt domes of Wienhausen–Sandlingen and Hänigsen–Wathlingen occurred during upper Quadraten-lower Mucronaten times. This uplift was of local rather than of regional significance, so that the salt masses formed islands in the Senonian sea. There is little connection, from the point of view of time, between this uplift and the known orogenic phases, although it might possibly be associated with the movements in the Harz mountains.

A number of well logs and a sketch map showing the well locations are given as well as sketch sections across the Hänigsen–Wathlingen salt-stock. S. E. C.

853. Importance of Geological Data in Acidizing of Wells. W. W. Love and P. E. Fitzgerald. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 616–626.—This paper discusses the various geological factors which affect acidizing. The chief of these are the physical characters (porosity, permeability) and composition of the rocks under treatment, and to a small extent their relationship stratigraphically and structurally. Of all the geological factors, however, which influence the results of acidizing, that relating to chemical composition of a formation is the most important. If the mineral constituents of a bed are not soluble in hydrochloric acid, the consideration of the other factors referred to is useless.

Generally, rocks which may be successfully treated with chemicals consist largely of calcium carbonate or calcium-magnesium carbonate. Other constituents which play an important part on acidizing results are: insoluble sand grains, shale, clay, iron and aluminium oxides, gypsum and anhydrite; all such constituents must be considered before acidizing.

The effect of clay and shale and the presence of certain iron and aluminium compounds in formations are mentioned. G. S. S.

854. Applying Phase-Equilibrium Data to Estimation of Oil and Gas Reserves. B. H. Sage and W. N. Lacey. *Oil & Gas J.*, 3.6.37, **36** (3), 124, 126, 128–131.—This article deals with the application of laboratory and field measurements to the estimation of oil and gas reserves, in the belief that a general macroscopic approach will yield results when a reservoir is so complex as to render impractical the more usual methods.

Assumptions made in order to simplify the complicated phase behaviour of the fluids are discussed, and the reservoir is considered as a system of variable volume from which hydrocarbons are removed only through wells or by loss from occlusion or isolation by advancing edge-water. These assumptions make it possible to evaluate the oil and gas reserves in terms of the oil and gas production, volumetric changes in the reservoir, and certain quantities derived from laboratory measurements. The evaluation of these various quantities is discussed in some detail. The field data required for the computations are listed and discussed, and the various terms employed are clearly defined.

The relationship between the reserves at any two given times is expressed in an equation, and from it the "formation volumes" at the given times are derived. The "formation volume" is solely a function of the equilibrium pressure and temperature and the composition of the mixture, making its determination possible, provided that the variables are known along with the necessary experimental information. The relationship between "formation volume" and gas–oil ratios is then obtained. Equations for the calculation of oil and gas reserves are then developed, and two hypothetical examples are worked out. The probable error resulting from an inaccurate occlusion factor is discussed, and it is shown that it is increasingly important when the reserve is less than the oil loss. Errors are also introduced by the change in character of the oil and gas over a wide pressure range. The problem is greatly simplified by the absence of edge-water encroachment. Some discussion follows of the errors and uncertainties involved in the method, and it is concluded that although it is fairly reliable for gas reserves, the inherent behaviour of hydrocarbons makes it impossible to calculate oil reserves with a corresponding accuracy. These, however, may be checked with the oil production over a fairly wide period.

A. J. H.

855. Aerial Survey is Essential in Modern Oil Operations. L. G. E. Bignell. *Oil & Gas J.*, 20.5.37, **36** (1), 70, 74.—The usual method of aerial surveying is to divide the area into 8-mile squares referred to as "grids." By flying at an altitude of just over 12,000 ft. the photographs have a scale of 1 in. to 1500 ft. The camera is automatically operated and the films are about 7 in. by 9 in. When a series of pictures has been obtained they are fitted together and placed on an illuminated glass screen and the essential details traced. Geological features such as faults and salt domes are often easily recognizable, and when used in conjunction with a surface reconnaissance, an area can be quickly and accurately surveyed for geological, geophysical or production purposes.

J. A. G.

Geophysics.

856. Geophysical Crews Busy in Mississippi, Alabama, Florida. M. Tucker. *Oil & Gas J.*, 3.6.37, **36** (3), 20, 21, 36.—The general structure in Mississippi is a gentle monocline dipping westward. Drilling evidence indicates the presence of an unconformity between the Palæozoic and Upper Cretaceous, the latter being represented by a marine series which increase in thickness from north to south. The Jackson Dome in Hinds and Rankine Counties produces gas from the Midway formation (Lower Eocene), and a heavy oil from the Selma Chalk (Upper Cretaceous). One salt dome has been discovered in Lamar Co., and may indicate a series of these structures along the coastal region.

The Appalacian Region of Alabama is underlain by a considerable thickness of strongly folded and faulted Palæozoic rocks, and this region is not considered likely to give commercial oil production. The Piedmont Uplift in the east central part of the State is mainly composed of granites, quartzites, etc., but the Coastal Plains in the south are underlain by Upper Cretaceous and Tertiary sands, clays, chalks and limestones, and this area is being thoroughly surveyed. A similar unconformity to that in Mississippi exists at the top of the Palæozoic.

The only carefully logged well drilled in Florida encountered the Jackson Limestone (Eocene) at 65 ft., followed by the massive Eocene Anhydrite at 2434 ft. The top of the Cretaceous was met at 3443 ft., and included 1200 ft. of the Selma Chalk. Shale breaks commenced at 4654 ft., and at 5322 ft. glauconitic sands were found which probably marked the top of the Eutaw. A non-calcareous sand (probably

Arkose) occurred at 6050 ft., and was followed by red sands and clays to a depth of 6102 ft., where granite was encountered.

Extensive geophysical work in these three States is planned, and favourable structures will be tested. J. A. G.

857. Recent Investigations in Radio Prospecting. V. Fritsch. *Petr. Z.*, 1.4.37, **33** (13), 14–16.—The starting point for all geophysical investigations by radio lies in the study of the geological "conductor" which, as a first approximation, may be compared to an ohmic resistance with a capacity in parallel. The electrical properties of such a conductor depend on its fluid content, and small variations in the water content have an amazing effect on its conductivity. Factors such as the presence of faults, bedding, etc., also have an appreciable effect.

The effect of frequency variations on the damping produced in an electromagnetic field by the presence of such a conductor is now being used in radio prospecting. This method has the advantage that it is independent of the absolute distance of penetration. New advances have also been made with the capacity method. In this connection, the Reiss method appears to have supplied the need for a method of measurement which, while very sensitive, yet can give reproducible results.

Experiments have lately been made with short-wave transmitters in mines, the lower bands being used. These waves can penetrate relatively thick sections, 25 m. waves being detected through 50 m. of cover. Their penetration through the mine workings, particularly along sections containing tramlines, pipes, etc., is, however, not so good as was expected. The field strength induced in various parts of a mine by a subsurface transmitter varies almost entirely with the linear distance from transmitter to receiver, assuming homogeneous material between them. Disturbed conditions have a definite damping effect. The generally unfavourable transmitting conditions for subsurface transmitters are mainly due to tramlines and other conductors being close to the antenna and to the low effective height of the latter.

S. E. C.

858. Experimental and Theoretical Investigations on Dispersion and Absorption of Elastic Waves. P. T. Sokoloff and V. I. Skriabin. *Beitr. zur Geophysik.*, 1937, **49** (1/2), 165–198.—As a result of these investigations it is shown that measurements of the elastic constants of sedimentary rocks by the usual methods have in most cases no true physical import. The most important departure of these rocks from the behaviour of ideal elastic bodies is due to elastic hysteresis, which results in deformation often exceeding the true elastic deformation. Experiments show, however, that Bennewitz and Becker's interpretation of the elastic hysteresis for glass and metals can be brought into accord with observations on various rock types. A series of equations is developed which serves as a basis for the experimental determination of Young's Modulus, the thrust modulus, and two other constants which give the ratio between the deformation due to true elastic action and that due to elastic hysteresis. These four constants were determined for more than 300 rocks, and in all cases the Poisson constant, taking into account the elastic hysteresis, fell between the limits of zero and 0·5.

The dispersion of elastic waves is considered in the light of the above theories, and formulæ are developed for velocity and absorption. The velocity increases with increasing frequency, and at infinite frequency it is equal to that given by the classic formulæ dealing with ideal bodies. Absorption also increases with increasing frequency. Results obtained from measurements on various rocks show that generally there is considerably more absorption with transverse waves than with longitudinal.

Consideration of the problems of reflection and refraction of these waves, taking into account hysteresis, shows that the amplitude of the reflected and of the refracted ray also depends on the frequency. S. E. C.

859. Laboratory Orientation of Well Cores by their Magnetic Polarity. E. D. Lynton. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 580–615.—It has been found that rock cores may be feebly magnetized, due to their magnetic minerals having lain long in the earth's field and to the presence of partly oriented particles derived from igneous rocks in which the magnetic effect was stronger. The possible differences resulting

from variations in the earth's field in different geological ages have been neglected in this work.

True cylindrical prepared cores, with square cut ends, and accurately centred, are required. In the original unshielded instrument a powerful magnet suspended in the weak field obtained by reducing the earth's field with fixed auxiliary magnets was used. Its deflection was noted for each 30° rotation of the horizontally placed core. In this way the magnetic axis of the core was determined, and the results were encouraging.

In the shielded instrument the core was rotated about its vertical axis below the lower one of a pair of astatic suspended magnets within a heavy iron shield which cut out the earth's field, and stray magnetic fields. Using cores of known orientation, 75% showed definite polarity and 50% were easily oriented. Some cores were too weak or gave ambiguous results due to the irregular distribution within them of minerals such as pyrite. The dip was found to have little effect on cores of strong polarity, and the magnetism appears to be retained for several years after the collection of the sample. Orientation within the limits of 15° seems possible, and if several cores from a single well are used, a reasonably good result may be expected.

By using the core in a horizontal position, 90% of the cores gave a determinable curve, particularly in the instrument which applied a slow continuous rotation to the core.

Provided that the top is known, cores can be oriented in the laboratory more quickly and with less expense than is required in the use of oriented core barrels.

In crooked holes a correction must be applied to the apparent dip and strike, and a simple instrument is described which makes these corrections in much less time than is required in computational methods. G. D. H.

Drilling.

860. Elevator for Servicing Producing Bore-holes. K. A. Apresov, V. N. Goroyan and S. I. Ashurli. *Azerb. Neft. Khoz.*, 1936 (4), 28.—The calculation of the bailer and cable elevations should be made according to the mean quadruple force, paying due attention to the interval, and thus calculating the excess load of the motor. In a preliminary calculation when the type of the motor is not yet known the coefficient of excess load should not exceed 1·6–1·7. The curve of the excess load as a function of the velocity of raising can be reproduced by a straight line with sufficient accuracy. In the bailer as well as in the cable elevations the time required for the equipment in the lifting operation does not depend on the construction of the drum, but is determined only by the capacity of the transmission. The maximum transmission speed should be so selected as to have the highest permissible limit without excessively increasing the number of revolutions of the drum. The lowest velocity of the transmission is given by the power of the motor and the limiting load on the hook. In the case of the multi-speed elevator, to assure a minimum of running the machinery, the intervals of depths corresponding to the lifting at various velocities should be identical, whilst the interval corresponding to the lifting with the lowest transmission ratio is determined by the equation $I_1 = (av_1 + b)/v_1$, where v_1 = the minimum speed, and a and b are constants of the overload. The intermediate speeds are determined by the equation

$$v_x = \frac{n-1}{\frac{n-k}{v_1} + \frac{k-1}{v_n}}$$

where $2 < k < n-1$ and where v_n = maximum speed, v_x = given velocity and k = no. of the gear. An elevator serving only deep bore-holes may have only two speeds. A bore-hole of 2000–2500 metres may be equipped with an electric motor of 75 kW.
For. Petr. Techn.

861. Drilling in Friable Clays. A. A. Linevskii, B. A. Rzhanitzyn and K. A. Tsarevich. *Azerb. Neft. Khoz.*, 1936 (4), 5.—A detailed description of successful and unsuccessful attempts to prevent cave-ins in the Azneft oilfields is presented. Among the successful applications are mentioned the use of water-glass, tannin and highly colloidal

clay loaded with barite. It is stated that an increase in viscosity of the solution takes place not only through water absorption and disintegration of the minerals, but also through filtration, the latter increasing considerably with increase in the viscosity of the solution, which is noticeable by the increase in the amount of froth in the gutters because of the increase in the viscosity of the solution leaving the bore-hole. Operations with loaded solutions yield a higher viscosity than with those containing water-glass, this being probably due to the fact that clay treated with water-glass loses its plastic properties acquired when absorbing water from ordinary solutions. Drilling with a solution of lime causes the minerals to stick to the bit, thus making drilling impossible. Drilling with untreated clay solutions causes the clay present in the bore-hole (*i.e.* present in the deposit) to absorb water from the clay solution, thereby causing cave-ins. The clay occluding the bit should be removed by flushing, and not by continuation of the drilling. The clay solution pumps should be able to produce a pressure of 80–100 atmos. The barite should have a grain-size of 4900 mesh, and should contain not more than 5–6% of larger size grains.

The following solutions were investigated: (1) a solution containing 7–12% rosin soap and 30–40% glycerine or sugar. The samples acquired a very thin film, which is strengthened with time, also retaining a certain amount of elasticity. (2) Hydrolysed gelatin solutions were prepared by heating gelatin with a weak solution of caustic on a water-bath for 6–8 hours. A solution containing 8–12% gelatin with the addition of up to 25% of $CaCl_2$, NaCl or KCl, etc., was investigated, solutions of KCl being satisfactory. Other ingredients formed cracks in the film. (3) Solutions of carpenter's glue (10–20%) with the addition of salt solutions or organic compounds in excess of 15% were satisfactory. Potassium salts were best among inorganic compounds, whilst organic admixtures were best with respect to mechanical qualities and particularly to elasticity. (4) Solutions of sodium silicates are the cheapest reagents. Solutions of a modulus 2·6–2·7 containing 15–30% of various sodium and up to 25% of potassium salts were used. Best results were obtained with additions of KNO_3, KCl and K_2CO_3. Additions of sugar, commercial glycerine, molasses, etc., in the amount of 10–40% on the weight of the silicate were beneficial, although they were more expensive. Introduction of 25–50% of a tannide prevents the samples from disintegrating through excess of moisture, although the incorporation of these solutions in clay is difficult. Hematite may be used as loading agent. In the case of cavities, a treatment with a paste of sodium silicate and then calcium hydroxide should be introduced. For. Petr. Techn.

862. Use of Temperature Measurements for Cementation Control and Correlations in Drill-holes. A. Deussen and H. Guyod. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 789–805.—Thirty days' idleness may be necessary for the rotary fluid to attain equilibrium and so show the true geothermal gradient. However, the resistance thermometer may be used in well temperature surveys of value for: (1) locating high-pressure oil and gas sands; (2) logging certain formations, and thus permitting correlation in cased or uncased holes; (3) locating liquid flows; (4) studying the movement of fluid behind casing; (5) locating and studying cemented zones.

Setting cement gives out a considerable amount of heat. Hence thermal surveys before and after cementing will show the top of the cement and indicate positions where there is a deficiency or large excess of cement, due to caving and other factors. The heat evolved in the setting of cement is largely dissipated in four or five days, and since the magnitude of the thermal anomaly depends on the difference in temperature between the setting cement and the adjacent formations, the cement is more easily located at shallow than at great depths.

When circulation is stopped, the rate of exchange of heat is much greater opposite water-sands than opposite shales. A temperature curve taken a few hours (within twenty-four hours) after ceasing circulation will show temperature changes at each geological contact. However, the results are complicated by many factors, for numerous surveys show that such a temperature curve cannot be correlated and does not correspond with the geological or electrical log. Yet in a certain area there are striking similarities pointing to the possibility of correlation, for some of the disturbing influences may be reliable thermic markers. This correlation also seems to be possible in cased and cemented holes, and in one instance the extreme wells were 1½ mls. apart. G. D. H.

863. Photoelectric Cell is Applied in Locating Water Intrusions. H. Guyod. *Oil & Gas J.*, 10.6.37, **36** (4), 50.—The instrument is an adaptation of the photo-electric cell to the location of a flow of clear water into a muddy water in a well. It will determine with a high degree of accuracy the place or places of entrance of formation waters which are usually clear. To condition the well preparatory to running the instrument, mud is dumped from a bailer or circulated by the slush pumps. This clouds the water except at the point where clear water is entering. After conditioning, a test run is made to determine the uniformity in translucency of the fluid. The instrument gives a low reading in the muddy fluid. To permit entrance of clear formation water the hydrostatic head of the fluid column is reduced by bailing or swabbing out a part of the fluid. As the photo-electric cell approaches the place where water is entering and diluting the conditioning fluid, the fact is shown by an increasing reading on the current meter. This mounts to a maximum at the actual point of entry, and then, immediately on passing it, falls to the normal reading for the conditioning fluid.

The cell current is led to the surface by the conductor cable on which the instrument is run, and depth and current are recorded simultaneously. It is possible to check by repeatedly passing the critical point. G. D. H.

864. Selection of Size of Oil Strings for Wells in California. E. K. Parks. *Oil Weekly*, 19.4.37, **85** (6), 18.—Although the costs of larger oil strings are estimated easily, economies demand the detailed consideration of the functions which vary with size. The pipe must resist bending, and greater strength per pound of steel is obtained from larger and heavier casing. A discussion is given on the influence of perforations on production and steel, and it is shown that the vertical slots reduce the section modulus least.

Pump diameters are limited by the size of small casings, and well cleaning is facilitated by the larger-sized casings. A formula is developed to show that a very slight bend requires a large clearance for the free passage of bailers or other internal pipe sections.

The size of hole as related to production rate indicates a great restriction of flow near the well bore. L. V. W. C.

865. Study of Problems Simplifies Operation in Matagorda Field. Anon. *Oil Weekly*, 26.4.37, **85** (7), 19.—A novel well completion programme, improved production practices and lower treating costs are the important contributions to the constructive field programme in the Van Vleck, Texas field. Depths vary from 7000 ft. to 8200 ft., but the gas/oil ratio has been held to such a low figure that no gas is wasted.

A full top to bottom casing programme is carried out, the hole is fully protected with regulation casing and production is obtained from some level above the bottom of the casing shoe, and gun perforation is performed. Formation testing, electrical logging and gun perforation enable wells to be completed to produce through perforations in the casing.

Cementing is done thoroughly, the objective being a full cement bond from bottom to a level well above the bottom.

Paraffin deposits have given trouble in several wells, and various scrapers and go-devils have been devised to reduce or eliminate this trouble. L. V. W. C.

866. Bottom-Hole Well Completion Methods on the Gulf Coast. I. W. Alcorn and J. U. Teague. *Oil & Gas J.*, 22.4.37, **35** (49), 60.—Wire screen has been in use on the Gulf Coast since the early days of spindletop and is necessary because of the loose producing formations of sand or sandy shale. The overlying beds are sufficiently low in structural strength that after the removal of quantities of oil, gas and water, the surface of the ground will sink.

The various ideas and methods adopted to-day may be listed as follows. Full-gauge hole drilled to bottom, blank casing run, cemented and perforated. Another method is to set casing on top of the sand or slightly below the oil-gas contact and screen or slotted pipe with blank liner and packer run. Or the well may be completed by the full hole cementing procedure, in which the slotted pipe or screen is run on the bottom of casing. These methods are explained in some detail. L. V. W. C.

867. Influence of Various Salts on Portland Cement. P. P. Budnikov and L. G. Gulinova. *J. Applied Chem.* (*U.S.S.R.*), 1936, **9**, 1937.—An addition of $CaCl_2$, $AlCl_3$, dolomite burned at 700° C. and waste obtained in the production of alumina from bauxite up to 1–2% increase the mechanical strength and the heat of hydration and reduce the setting period. These additions can be recommended for winter construction work because of their higher heat of hydration. Sodium fluosilicate has little influence on the mechanical strength, but reduces the setting period by 90%. $MgCl_2$ increases the mechanical strength and reduces the setting period and the heat of hydration of the cement. $BaCl_2$, Na_2CO_3, $Ca(OH)_2$ and NaOH cannot be recommended as additions to cement on account of their reducing influence on its mechanical strength.
For. Petr. Techn.

868. Drilling Patents. B. Young. U.S.P. 2,075,878, 6.4.37. Well casing head.

J. E. Brantly. U.S.P. 2,075,882, 6.4.37. A method of cementing well casing by simultaneously pumping two successive volumes of cement downwards through the casing, discharging one volume around the shoe and the other at a point higher in the well.

G. A. Humason. U.S.P. 2,075,899, 6.4.37. Drilling control head.

R. T. Roye. U.S.P. 2,075,912, 6.4.37. Well packer.

C. E. Reed. U.S.P. 2,075,997, 2,075,998, 2,075,999, 2,076,000, 2,076,001, 2,076,002, and 2,076,003, 6.4.37. Roller cutter, spindle and bearing assembly for rotary drills.

A. J. Penick and K. T. Penick. U.S.P. 2,076,042, 6.4.37. Pressure fluid-operated blow-out preventer.

C. E. Burt. U.S.P. 2,076,063, 6.4.37. A rotary core barrel in which is arranged a nozzle with orifices in communication with the core tube whereby flow of fluid through the nozzle will cause a suction tending to evacuate the core tube.

A. G. H. Straatman. U.S.P. 2,076,211, 6.4.37. An apparatus for surveying subsurface strata comprising a metallic element of relatively large heat capacity and capable of following the general temperature trend of the bore-hole fluid. Means supplied to register the temperature difference.

G. Meyer. U.S.P. 2,076,301, 6.4.37. Multiple ring packer with a series of packing and spacing rings and means for expanding the packing rings into contact with the bore-hole walls.

W. T. Wells, C. H. Barnes and L. Spencer. U.S.P. 2,076,307, 6.4.37. A bridging plug.

W. T. Wells. U.S.P. 2,076,308, 6.4.37. A well-heating device. Comprising a container, an explosive endothermic reacting substance and means for igniting this substance.

A. J. Zschokke. U.S.P. 2,076,313, 6.4.37. A bridging plug and retrieving tool.

A. J. Zschokke. U.S.P. 2,076,314, 6.4.37. A bridging plug and setting tool.

I. Thomas. U.S.P. 2,076,684, 13.4.37. By-pass joint for oil well testers.

E. L. Barker. U.S.P. 2,076,761, 13.4.37. Packer and setting tool.

G. F. Grimmelsman. U.S.P. 2,076,837, 13.4.37. Core catcher.

M. Spencer and J. R. Beauchamp. U.S.P. 2,077,022, 13.4.37. Marine derrick structure comprising a plurality of piles arranged to support the derrick, a plurality of horizontal beams mounted on these piles to support the structure, hangers suspended from these beams and a tank supported by the hangers.

H. J. Eastman. U.S.P. 2,077,381, 20.4.37. A calibrating and testing tool for bore-hole surveying instruments.

G. A. Humason. U.S.P. 2,077,480, 20.4.37. Combination well head and Christmas Tree.

G. E. van Voorhis. U.S.P. 2,077,911 and 2,077,912, 20.4.37. Valved coupling for gas wells.

K. C. Ten Brink. U.S.P. 2,078,107, 20.4.37. Paraffin remover for oil wells.

E. Burns and H. P. Wickersham. U.S.P. 2,078,122, 20.4.37. Travelling block.

N. I. McCann. U.S.P. 2,078,401, 27.4.37. Casing cutter.

C. H. Sweet. U.S.P. 2,078,426, 27.4.37. A method for locating the point at which an object is fixed in a well by maintaining a longitudinal strain on the object and applying a strain to the object at vertically spaced points to locate the lowest point at which application of the strain varies the strain maintained on the object.

W. L. Clark. U.S.P. 2,078,482, 27.4.37. Bottom-hole intermitter.

H. D. Wilde, Jr. U.S.P. 2,078,623, 27.4.37. Bottom-hole pressure recording device.

H. C. Yarbrough. U.S.P. 2,079,140, 4.5.37. Formation tester.

J. A. Zublin. U.S.P. 2,079,142, 4.5.37. Bearing assembly for drilling bits.

G. E. Cameron. U.S.P. 2,079,431, 4.5.37. A process for plugging off salt water producing sands in a well producing both oil and salt water, by introducing a solution of soap into the well and permitting the solution to flow into both the oil and salt water sands. The soap in contact with the salt water is salted out to plug the pores of only the salt water sand.

A. A. Haldeman. U.S.P. 2,079,449, 4.5.37. A well drilling rig attachment for drilling wells at an angle to the vertical. Drill pipe is run in and pulled out on an inclined rack.

H. L. McQuiston. U.S.P. 2,079,517, 4.5.37. A method of filling cavities in the walls of wells during drilling by the use of a sealing mixture of a setting cement slurry and ground paper admixed in suitable proportions.

H. L. McQuiston. U.S.P. 2,079,518, 4.5.37. A method of supporting a pipe within a bore-hole and of preventing the loss of the supporting medium into porous formations while the medium is in the fluid state. A pipe is placed in the well and a supporting medium of setting cement slurry and ground paper is introduced into the top of the pipe and forced down by pump pressure.

W. A. Abegg. U.S.P. 2,079,646, 11.3.37. Tubing head.

R. C. Baker and C. E. Burt. U.S.P. 2,079,830, 11.5.37. Apparatus for blanking and cementing off perforated casing in a well.

G. L. Labarre. U.S.P. 2,079,941, 11.5.37. Core catcher, retainer and seat for core barrel.

C. A. Dean. U.S.P. 2,080,116 and 2,080,117, 11.5.37. Roller shoulder bit.

D. A. Murphy. U.S.P. 2,080,225, 11.5.37. Swivel. L. V. W. C.

Production.

869. Development Practice in the South Bay City Field. J. A. Kornfeld. *Petr. Eng.*, April 1937, **8** (7), 121.—Among the features of modern development practice in the South Bay City Field, Coastal Texas, are gun perforation, squeeze-job cementing at depths ranging from 8190 to 9361 ft., wire line coring under pressure and heavy equipment including 20-in. slush pumps with compounding arrangement.

Most of the derricks in use are 136 ft. in height and have a 30-ft. base, with a capacity load of 800,000 lb. The sub-structures for these derricks have a capacity load of 1,000,000 lb.

The well head fittings are all tested to 6000 lb. L. V. W. C.

870. Wells of Gravel-Wall Type. C. M. Willis. *Oil Weekly*, 26.4.37, **85** (7), 46.—The gravel-wall type of well has gained wide acceptance as solving many of the water-production problems. This type of water well is used only where underground water is found in sand and gravel. The removal of large volumes of water may result in sand coming in with the water causing a shutting off of the water or sanding up of the pumping equipment. To avoid this several types of gravel-wall water wells have been constructed.

One type of gravel wall water well is dug 54 in. in diameter, using 54-in. casing and manual digging is continued until water is encountered. The casing is forced down until the casing reaches bedrock or shale.

Concrete tile casing is used, and the space between the setting tube and the outer casing is filled with pea-sized gravel. A short joint of 36-in. steel casing is placed at the surface to keep back the surface waters. L. V. W. C.

871. Chemical Clean-out of Oil Wells in California. M. W. Morris. *Oil Weekly*, 19.4.37, **85** (6), 23 and *Oil & Gas J.*, 22.4.37, **35** (49), 48.—Successful cleaning out of material which obstructs the entrance of production by the plugging of perforations or the face of the sand has been made possible by chemical treatment. Mud sheaths, carbonate scale deposited from the well water and waxy-asphaltic residues have been removed.

Although there have been failures, chemical clean-out work has proved profitable. Many of these failures have resulted from an ill-advised selection of wells or the mis-application of chemicals. Where applicable, chemical clean-out methods are more efficient than the older mechanical methods. L. V. W. C.

Transport and Storage.

872. Pipe-Line Scraper Trap of Straight-run Design. G. Sterrett. *Petr. Eng.*, April 1937, **8** (7), 105.—As an ordinary scraper would lose its effectiveness by becoming clogged with paraffin early in its run, a scraper trap was provided in the line. Advantage was taken of the ease of manipulation of standardized grooved-end couplings, and these have been incorporated in the design.

A description of the scraper is given, together with a diagrammatical lay-out of the trap section as incorporated in the main line. L. V. W. C.

873. Pipe Plant Reclamation. K. C. Hayes. *Oil Weekly*, 19.4.37, **85** (6), 50.—The restoration of the usefulness of pipe and the prolongation of the life is the object of each method of reclamation. The plant method of reclamation has been proved to be very efficient and the practice is becoming more popular. The author gives information abstracted from practices now in use in plant operations. Since the start of the plant method of reclamation the total amount of pipe reconditioned has probably reached a total of 1000 miles. L. V. W. C.

874. Corrosion Resistant Steel for Tankers. A. B. Gowan. *World Petr.*, May 1937, **8** (5), 40.—The almost universal use of mild steel in the construction of tankers is due both to its superiority over iron and to the standardization of shipbuilding methods based on steel of known quality and general availability. However, it has a lower corrosion resistance than iron, and a low tensile stress (26–32 tons per sq. in.) necessitating the use of heavy low stressed members and heavy continuous doubling plate.

High tensile bullet-proof or armour-plating steels of the type used in warships are too expensive, and frequently have insufficient corrosion resistance, whilst they are difficult to fabricate.

A particular alloy which possesses improved resistance is a chromium copper steel with the following composition:

$$\text{Cr } 0{\cdot}70 - 1{\cdot}10\%;\ \text{Cu } 0{\cdot}25 - 0{\cdot}50\%;\ \text{Mn } 0{\cdot}70 - 1{\cdot}0\%;$$
$$\text{C} \gtrless 0{\cdot}30\%;\ \text{Si} \gtrless 0{\cdot}20\%;\ \text{S} \gtrless 0{\cdot}05;\ \text{and P} \gtrless 0{\cdot}05\%.$$

Exposure tests in corrosive tidal water, containing sewage and works effluents, showed 50% greater loss in weight of the mild steel specimens than of the chromium copper steel, the latter specimens being characterized by the absence of pitting. The

alloy in question possesses the following physical characteristics. Tensile strength 37–43 tons per sq. in.; yield point (on ½ inch thick material) 23 tons per sq. in.; elongation on 8 ins. 17% min.; reduction of area 40% min. It is in commercial production, and its characteristics have been fully studied. The cost is about 25% greater than that of mild steel, but owing to its greater strength the weight required for a modern tanker could be reduced by 10–15%. The alloy is particularly resistant to sulphur-bearing gases. C. L. G.

875. Influence of Films on the Incipient Corrosion of Iron. A. H. Stuart. *Paint Manufacture*, 1937, **7** (6), 179–182.—The electrolytic basis of the corrosion of iron is discussed and three general methods of protection are stated.

(*a*) The surface may be covered with a film impervious to air and moisture, *e.g.* tinplate.

(*b*) The surface may be covered with a film which in addition to mechanical cover will, in the event of an electrolyte penetrating to the iron surface, set up a condition in which Fe is the cathode, *e.g.* (1) Zn film in galvanized iron, (2) priming coat of red lead.

(*c*) Inhibitors may be mixed with the attacking fluid and form a protective film or render the distribution of electrostatic forces such as to oppose the transference of Fe atoms to Fe ions.

There is a great difference of opinion as to the value of graphite in anti-corrosive paints. It is cathodic to iron and can, under special conditions, be the cause of corrosion. In general, however, it is either inert, or even beneficial.

The Thompson test for pigments in which a specimen of iron is exposed to a mixture of pigment in water through which air is bubbled for long periods needs to be applied to graphite with discrimination. It appears that behaviour of graphite depends largely on its particle size and on the nature of the iron specimen used in the test.

Thus in a test made by the author, a coarse graphite caused an increase in corrosion of 74%, whilst a colloidal graphite resulted in a decrease of 39%. Other cases of the anti-corrosive properties of colloidal graphite are given.

It is recommended that for the prevention of corrosion, a priming coat containing rust inhibitors should be used followed by two coats of graphite paint.

The author has carried out tests on the electrical properties of graphite, and finds that films are less anodic than bare metallic iron.

He concludes that in suitable form graphite has three outstanding qualities as an anti-corrosive pigment.

1. It is extremely inert and resistant to most corrosive agents.
2. Its crystalline form enables an unusually homogeneous layer to be produced.
3. Its electrical conductivity will favour the transfer of ions of Fe to the metallic state, whilst the close-lying layer will oppose the reverse process, thus reducing the rate of corrosion. D. L. S.

Gas.

876. Complete Analyses of Natural Gas. W. F. Fulton. *Oil & Gas J.*, 20.5.37, **36** (1), 60.—Precision methods of analyses of natural gas used by a large gas company are described. Products which are determined are as follows: carbon monoxide, total sulphur, hydrogen sulphide, carbon dioxide, oxygen, helium, methane and heavier hydrocarbons and nitrogen. Where methods employed differ from normal standards, a full description is given. A test with white mice to investigate the toxic properties of odorants is described. Natural gas does not contain carbon monoxide and no trace of oxygen in gases from high-pressure wells or lines has been found.

Flow calorimeters are satisfactory for determining routine calorific values, provided that they are properly checked and calibrated. For this purpose a precision calorimeter, similar to the one used by the Bureau of Standards in determining the heat of combustion of hydrogen, was constructed. Construction and operation of the apparatus are described. The accuracy of the calorimeter is ± 0·25 B.Th.U. per 1000 cu. ft. of gas. R. A. E.

877. Patents on Gas. Mannesmannröhren-Werke & Ruhrchemie A.-G. E.P. 464,242, 14.4.37. Production of synthetic hydrocarbons from oxides of carbon and hydrogen.

Ruhrchemie A.-G. E.P. 465,183, 3.5.37. Acetylene production from hydrocarbon gases.

G. W. Johnson. E.P. 465,668, 13.5.37. Conversion of CO and H_2 into gaseous and/or liquid hydrocarbons and their derivatives by contacting the gaseous mixture at 275–425° C. with an iron oxide catalyst. W. S. E. C.

Crude Petroleum.

878. Patents on Crude Oil. M. De Groote. U.S.P. 2,076,624, 13.4.37, 2,077,745, 20.4.37, 2,078,654–2,078,655, 27.4.37, M. De Groote & B. Keiser. U.S.P. 2,077,230, 13.4.37, 2,078,652–2,078,653, 27.4.37, M. De Groote and A. F. Wirtel. U.S.P. 2,077,229, 13.4.37, 2,077,746, 20.4.37, M. De Groote, B. Keiser, L. L. Faure and A. F. Wirtel. U.S.P. 2,076,623, 13.4.37. Breaking of petroleum emulsions of the water-in-oil type by means of demulsifying agents. W. S. E. C.

Cracking.

879. Motor Fuel from Oil Cracking. G. Egloff, E. F. Nelson, and J. C. Morrell. *Ind. Eng. Chem.*, 1937, **29** (5), 555.—A brief account is given of the Fischer–Tropsch synthesis of hydrocarbons, or the "Kogasin Process," by the catalytic treatment of water gas. The authors then describe experimental work carried out in order to produce a high yield of satisfactory octane number gasoline. By fractionating a very light gasoline from the kogasin, subjecting the naphtha and bottoms to selective cracking conditions, and polymerizing the olefins present in the gas, an overall yield of 84% of 66 octane number gasoline was obtained. H. E. T.

880. Patents on Cracking. C. L. Johnston. U.S.P. 2,076,847, 13.4.37. Improved method of cleaning furnace tubes.

L. A. Mekler. U.S.P. 2,076,854–2,076,855, 13.4.37, and W. H. Minkema. U.S.P. 2,076,856, 13.4.37. Improved furnace for heating fluids.

E. J. Houdry. U.S.P. 2,078,247, 27.4.37. Catalytic cracking of hydrocarbon oils. W. S. E. C.

Hydrogenation.

881. Patents on Hydrogenation. G. W. Johnson. E.P. 463,333, 22.3.37. Production and recovery of light hydrocarbons from gaseous mixtures obtained in destructive hydrogenation of carbonaceous substances in the liquid phase. The pressure is released on the liquid products and the gases liberated are passed for hydrogenation treatment in the gaseous phase.

Soc. Ind. des Carb. et Solvents. E.P. 463,444, 31.3.37. Method of depositing catalyst metals on metallic supports for hydrogenation processes. Vapours of the carbonyl or ethyl compound of the metal are conveyed over metallic supports, which are heated to a temperature to decompose the vapours, and the metal is deposited directly on the supports.

International Hydrogenation Patents Co., Ltd., and I.G. Farbenindustrie A.-G. E.P. 463,602, 2.4.37. Destructive hydrogenation of coal comminuted with an addition of water and kneading with a sludgy residue from the destructive hydrogenation of coal. The kneading is accelerated by adding benzine or tetrahydronaphthalene.

G. W. Johnson. E.P. 464,308, 15.4.37. Conversion of CO and H_2 into liquid, solid or gaseous hydrocarbons in the presence of a catalyst, *e.g.*, iron or aluminium oxides.

Oesterreichisch Amerikanische Magnesit. A.-G. E.P. 464,667, 22.4.37. Hydrogen production by conversion of CO and steam in the presence of catalysts, *e.g.*, MgO,K_2CO_3 containing iron oxide.

N.V. de Bataafsche Petroleum Mij. E.P. 464,957, 28.4.37. Catalytic dehydrogenation of *iso*butane using as catalyst Al or Cr at 500–700° C.

International Hydrogenation Patents Co., Ltd. E.P. 465,024, 29.4.37. Catalytic hydrogenation of polymers boiling below 225° C. of unsaturated hydrocarbons, *e.g.*, polymers of *iso*butene formed in the hydrogenation of octenes to produce *iso*-octane.

International Hydrogenation Co., Ltd., and I.G. Farbenindustrie A.-G. E.P. 465,413, 5.5.37. Hydrogenation of carbonaceous substances using electrolytic hydrogen. W. S. E. C.

Polymerization.

882. Patents on Polymerization. Universal Oil Products Co. and A. L. Mond. E.P. 463,864, 7.4.37. Preparation of phosphoric acid catalyst for use in polymerizing unsaturated hydrocarbons.

Universal Oil Products Co. and A. L. Mond. E.P. 464,671–464,672, 19.4.37. Selective polymerization of olefines using a phosphoric acid catalyst in the presence of a controlled amount of added steam or equivalent aqueous fluid.

S. L. Langedijk and A. J. van Peski. U.S.P. 2,076,201, 6.4.37. Catalytic polymerization of unsaturated hydrocarbons using as catalyst a molten salt mixture containing aluminium chloride and a chloride of another metal in molecular equivalent proportions. W. S. E. C.

Refining and Refinery Plant.

883. Badger Vacuum Pipe Still. Y. Kawachi. *J. Fuel Soc. Japan*, 1937, **16** (173), 15.—The vacuum pipe still of the Osaka Oil Co. was specially designed for small-scale continuous operation, the daily throughput being 90 kilolitres. It consists of a pipe-still furnace, bubble tower, condensers, etc., and is compactly installed within an area of 160 sq. m. In the furnace the convection tube bank is placed near the bottom below the burners to obtain sufficient and uniform heating of the radiant bank placed in the roof. The bubble tower is arranged to give an overhead stream, four side streams and a residue. It is stated that when redistilling machine oil, 95% can be recovered without any decomposition. An example of the working results on an asphaltic stock is given. G. R. N.

884. Treating Light Distillates by the PbS Process. D. B. Nutt and J. A. Altshuler. *Nat. Petr. News*, 28.4.37, **29** (17), 67.—In this process sour gasoline is contacted with a fine suspension of PbS in caustic soda solution, carefully controlled quantities of air being passed through the contactor. Soluble lead salts formed are precipitated by sodium sulphide solution fed in with the other reagents. The PbS is regenerated periodically by washing with hot water. The concentration of the NaOH solution is important. The process is claimed to offer the following advantages over the doctor process: (1) Costs decreased by 50%. (2) Smaller decrease in octane number. (3) Decreased loss in colour. (4) Decreased treating losses. (5) The absence of free sulphur in the process reduces the likelihood of a poor copper strip test after treating. The mechanism of the process is the subject of much discussion. H. G.

885. Refining by Selective Solvents. G. Free. *Oel u. Kohle*, 1937, **13**, 420.—Review of technical and patent literature up to 1936. P. G. H.

886. Individual Suitability of Various Bleaching Earths for Bleaching Various Oils. E. Erdheim. *Petr. Z.*, 14.4.37, **33** (15), 4; *Öl, Fette, Wachse*, 1937 (2), 24–7.—This is a continuation of the author's work on bleaching earths (cf. Abstr. nos. 560, 796–797, 1487 of 1936 and 539 of 1937); the bleaching capacities of four earths were tested on three samples of rape and mineral oils. The degree of activity was found to vary with the oil used and the amount used in the tests. It is claimed that no standard oil or quantity of earth sample can be selected for evaluating the bleaching capacity of the earths. The author recommends carrying out bleaching tests on various oils and pre-

paring curves showing the relationship between the bleaching capacity of various proportions of the individual earths on each oil. These curves can be used as a basis for evaluating the earth. W. S. E. C.

887. Patents on Plant. G. F. Watts. U.S.P. 2,076,871, 13.4.37. New pipe heater for the distillation of petroleum oils. W. S. E. C.

Chemistry and Physics of Petroleum.

888. Chemical Research on Petroleum Lubricating Hydrocarbons. E. André and A. Maurel. *Ann. des Comb. Liq.*, 1936, **11**, 1127–1148.—The authors describe the application of the Wurtz reaction (the action of silver acetate on halogenated derivatives of hydrocarbons) on chlorinated compounds obtained by the treatment of petroleum jelly with chlorine. They have established that 18–20% of the total halogen is replaced by the acetyl group, whilst 45–47% of the balance of the halogen is not affected by the reaction.

By the action of mixed solvents, consisting of mixtures in variable proportions of ethyl acetate and alcohol, it was possible to concentrate the acetic esters in those fractions of the mixture which were most soluble in the solvents. It is planned in future to describe the saponification of these esters and the extraction of the alcohols so formed.

Anticipating the latter work, it is stated that the least condensed molecules in the petroleum jelly are those which possess the greatest chemical reactivity, whilst the hydrocarbons containing 30 carbon atoms and over are much less reactive.

W. E. J. B.

889. Influence of *cyclo*Hexene Concentration in the Alkylation of Benzene by *cyclo*Hexene. Dealkylation of *cyclo*Hexylbenzenes. B. B. Corson and V. N. Ipatieff. *J.A.C.S.*, 1937, **59**, 645–647.—The direct alkylation of benzene with *cyclo*hexene offers a convenient method for the preparation of *cyclo*hexylbenzenes. The reaction is catalysed by aluminium chloride and by sulphuric acid.

The nature of the products formed, which may be mono-, di-, tri- and tetra-*cyclo*hexylbenzenes, depends on the relative amount of *cyclo*hexene present.

The mono-, di- and tri-*cyclo*hexylbenzenes react with *cyclo*hexene to form higher derivatives. The di-, tri- and tetra-*cyclo*hexylbenzenes react with benzene in the presence of aluminium chloride to form lower derivatives.

The paper contains experimental details as well as physical constants for the various hydrocarbons prepared. W. E. J. B.

890. Photo-Iodination of the Butenes, Propylene and Ethylene at Low Temperatures. Preparation and Photolysis of 1 : 2-Di-Iodobutane. G. S. Forbes and A. F. Nelson. *J.A.C.S.*, 1937, **59**, 693–697.—The four butenes, propylene and ethylene, all exceptionally pure, were quantitatively photo-iodinated in chloroform at − 55° C. in light of λλ 436, 546 and in two cases 644 mμ. Competing thermal reactions were paralysed.

The quantum yields for the different olefins at − 55° C. (concentrations and light intensity being the same) vary as much as forty-fold, due perhaps to a difference in the activation energy of a secondary thermal reaction common to all the photo-iodinations.

Quantum yields at − 55° C. fall off with decreasing frequency to a value of the order of 0·01 at λ 644 mμ.

The thermal reaction scheme of Schumacher does not harmonize with the photochemical results at − 55° C. The rate of photo-iodination is more nearly in proportion to concentration of olefin and of iodine and to light intensity.

At low temperatures di-iodobutane (presumably the 1 : 2-isomer) was prepared as a white solid in a state of reasonable purity, and photolyzed at − 60, − 20 and + 25° C. The quantum yield at 25° C. is nearly the same as that for symmetrical ethylene iodide.

W. E. J. B.

891. Chlorination of Pentane. S. S. Nametkin and A. G. Serebryanikova. *J. Applied Chem.* (*U.S.S.R.*), 1936, **9**, 1428.—Pentane (ex petroleum) was chlorinated in a special

apparatus at 210–260° C. yielding 0–9·2% (by weight of monochloride) of polychlorides. The yield of polychlorides depends on the ratio $C_5H_{12} : Cl_2$ passed through the reaction chamber (a coil 12–18 metres in length), the velocity of flow and the temperature. Thus the yield was zero at a 16 : 1 ratio, 2100 ml./hr. and 240° C.; it was 1·5% at 6 : 1 ratio and 215° C. and 4% at 5·2 : 1 ratio and 220° C. An increase in velocity of the mixture lowered the yield, as did a decrease in temperature, but an increase in length of reaction chamber compensated this latter effect. The yield of polychlorides was highest (9·2%) with insufficiently dried pentane and chlorine, although in this case carbonization was also observed. For. Petr. Techn.

892. Reaction Between Sulphur Dioxide and Olefins. V. Structure of the Polysulphones from Olefins of the Type $RCH{:}CH_2$. F. J. Glavis, L. L. Ryden and C. S. Marvel. *J.A.C.S.*, 1937, **59**, 707–711.—Those polysulphones prepared from sulphur dioxide and olefins, which dissolve in liquid ammonia, are converted by this treatment into cyclic disulphones.

Styrene (phenylethylene) adds sulphur dioxide to give a polysulphone.

Evidence is presented to show that polysulphones prepared from olefins of the type $RCH{:}CH_2$ are such that like parts of the hydrocarbon residues are linked through the sulphone groups. W. E. J. B.

893. Hydro-Polymerization. V. N. Ipatieff and V. I. Komarewsky. *J.A.C.S.*, 1937, **59**, 720–722.—This paper describes the "hydro-polymerization" of amylene and *iso*butene in the presence of the hydrogenating catalysts, reduced iron and nickel oxide, together with the polymerizing agents magnesium, zinc and aluminium chloride. In the presence of such mixed catalysts two reactions occur simultaneously: (1) polymerization of the olefin hydrocarbon, (2) hydrogenation of the polymer so formed.

The experiments indicate that magnesium chloride and zinc chloride do not act as polymerizing agents under the experimental conditions employed. Additionally, when the experiments were conducted under conditions not favourable to hydrogenation, the hydrogenation did not take place, even in the presence of a hydrogenation catalyst, and, at the same time, no polymerization occurred; thus the reaction of hydropolymerization is a real simultaneous reaction. At 300° C. under a hydrogen pressure of 80 kg./sq. cm. in the presence of reduced iron and magnesium chloride amylene gave decane. Its formation is explained by the polymerization of 2 molecules of the amylene with simultaneous hydrogenation. Under very similar conditions *iso*butene gave 2 : 2 : 4-trimethylpentane, *i.e.*, "*iso*-octane," and *iso*dodecane.

W. E. J. B.

894. Hydration of Unsaturated Compounds. V. The Rate of Hydration of Acetylene in Aqueous Solution of Sulphuric Acid and Mercuric Sulphate. R. H. Frieman, E. R. Kennedy and H. J. Lucas. *J.A.C.S.*, 1937, **59**, 722–726.—Acetylene undergoes homogeneous hydration to acetaldehyde in aqueous solutions in the presence of mercuric sulphate and sulphuric acid. The initial rate of hydration is first order with respect to the acetylene concentration and second order with respect to the mercuric sulphate concentration, whilst the rate at time t has an apparent four-thirds power dependence on the acetylene. This last is believed to result from the formation of a complex between mercuric sulphate and acetaldehyde.

A probable mechanism of the hydration involves the formation of an intermediate complex between 1 molecule of acetylene and 2 molecules of mercuric bisulphate, and the reaction of this complex with water, in the presence of an acid, to form vinyl alcohol, which rearranges to acetaldehyde.

The bromate–bromide method of determining unsaturation is applicable to aqueous solutions of acetylene, provided there is present a soluble mercuric salt the molal ratio of which to total halide is greater than unity. W. E. J. B.

895. Oxidation of Paraffin. Ubbelohde and Gralheer. *Oel u. Kohle*, 1937, **13**, 402–403.—Eisenstein (1915) had found that oxidation to fatty acids was influenced by the moisture content of the oxygen. His experiments were repeated by the authors, but with varying content of H_2O vapour in the O_2. Lignite paraffin (s. pt. 54° C.) was oxidized with O_2 at 125° C. (20 litres per hour) in presence of a catalyst. In all

cases an induction period of about 1 hour was found, during which the paraffin became dark. The acid value then rose regularly and the colour lightened. The acid value after 10 hours was not materially affected by moisture content of the O_2 (up to 4% vol. H_2O).

Very small variations in temperature, due to the exothermic nature of the reaction, were found more apt than H_2O vapour content to cause variations in acid value.

P. G. H.

896. Optical Properties and Polymorphism of Paraffins. C. D. West. *J.A.C.S.*, 1937, **59**, 742–743.—When a molten paraffin or similar long-chain compound is allowed to solidify in a film on a flat glass surface, the film, in spite of being turbid to the naked eye, and showing many randomly oriented small crystals under the microscope, still has sufficient homogeneity to show a peculiar effect when examined with a total reflection refractometer. Instead of one boundary between total and ordinarily reflected light, two such boundaries of a somewhat diffuse character are observed, separated by an interval of up to 0·05 unit in the refractive index scale. The state of polarization of the light at these boundaries proves that the film is optically equivalent to the basal section of a uniaxial positive crystal.

The author refers to the published measurements of Page (Abs. 1085, 1936) on five natural paraffins with m.pts. in the range 49·4–60·6° C., and alleges that Page assigned an incorrect optical characteristic to his films and that certain calculations are therefore in error. The paper describes a simple procedure for measuring the refractive indices of materials which solidify to form transparent uniaxial films. The dimorphism of solid dicetyl ($C_{32}H_{66}$) is demonstrated by refractrometric measurements, and approximate values of its optical constants are given over the temperature range 20–80° C.

W. E. J. B.

897. New Metal Halide Catalysts for Hydrocarbon Reactions. A. V. Grosse and V. N. Ipatieff. *J. Org. Chem.*, 1937, I, 559.—Several new metal halide catalysts have been investigated for the alkylation of an aromatic with an olefinic hydrocarbon. These halides included beryllium chlorine, titanium tetrachloride, zirconium tetrachloride, hafnium tetrachloride, thorium tetrachloride, and the pentachlorides of tantalum and columbium. The reaction studied was the classical one discovered by Balsohn—namely, the alkylation of benzene with ethylene. The reaction carried out in a rotating autoclave at moderate temperatures proceeded smoothly, and in all cases yielded a mixture of mono- and poly- up to hexaethyl benzene.

H. E. T.

898. Mechanism of Thermal Polymerization and Polycondensation. H. Dostal, H. Mark, and R. Raff. *Ind. Eng. Chem.*, 1937, **29** (5), 595.—A brief summary is presented of the authors' work on the kinetics of some characteristic thermal polymerization processes. The mathematical treatment of polymerization and condensation processes investigated to date is given in outline.

H. E. T.

899. Heat of Mixing of Di*iso*Butylene and *iso*Octane. W. D. Kennedy and G. S. Parks. *J.A.C.S.*, 1937, **59**, 761–762.—The authors report some direct calorimetric determinations of the heats of mixing of di*iso*butylene and *iso*octane. Ten separate determinations of the heat of mixing were made, in forming solutions ranging from 0·17 to 0·91 mole fraction of *iso*octane.

In the *iso*thermal mixing process there appeared a small endothermic effect. This heat absorption reached a maximum for the formation of a solution containing 0·49 mole fraction of the *iso*octane. In this case the heat of absorption per mole of solution was 12·1 (± 1·0) cal. This heat effect is very minute—in fact, only 1·3% of the effect previously recorded in the formation of a comparable solution of benzene and normal hexane. Thus the solutions of di*iso*butylene and *iso*octane are, for practical purposes, almost perfect.

W. E. J. B.

900. Inhibition of Thermal Decomposition of *n*-Butane by Nitric Oxide. L. S. Echols and R. N. Pease. *J.A.C.S.*, 1937, **59**, 766–767.—These authors report that the decomposition of *n*-butane is strongly inhibited by small amounts of nitric oxide.

Measurements over a wide range of initial nitric oxide pressure, indicate a region of maximum inhibition at about 20 mm.

It is concluded that the decomposition of *n*-butane under the following conditions is largely a chain reaction: Initial pressure of butane = 200 mm., temperature 500° C. Reaction carried out in a potassium chloride coated reaction bulb.

W. E. J. B.

901. Fractional Distillation of Cracked and Polymer Gasolines. C. O. Tongberg, J. E. Nickels, S. Lawroski, and M. R. Fenske. *Ind. Eng. Chem.*, 1937, **29**, 571.—A cracked and a polymer gasoline have been fractionated in a 39-foot column with approximately one hundred theoretical plates, the average reflux ratio being 40 to 1. The cracked gasoline fractionates similarly to a straight-run gasoline (previously reported), as far as the general shape of the refractive index curve is concerned, whereas the polymer gasoline differs considerably, having no sharp breaks in the curve, the range of refractive index being rather narrow.

Blends of the cracked gasoline varied in octane number from below 41 to 75, whilst for the polymer gasoline the variation was from 72 to 82. H. E. T.

902. Ethane Pyrolysis in the Presence of Steam. D. S. Cryder and D. J. Porter. *Ind. Eng. Chem.*, 1937, **29** (6), 667.—The work reported in this paper was undertaken in order to determine the mechanism of ethane decomposition in the presence of steam, and the course of any interaction between the gases, as a first step in the study of the effect of steam on the thermal decomposition of higher hydrocarbons. Various ethane–steam mixtures were passed through a silica tube over a wide range of temperatures. The temperature range was 498–1000° C., the time of an experiment 8–30 minutes, and the contact time 1·41–4·31 seconds. At each temperature, data were obtained for the decomposition of the gaseous mixtures with the tube empty, with a silica-gel catalyst and with a catalyst composed of silica gel impregnated with nickel. The results obtained indicate that the decomposition of ethane proceeds according to the simple first-order reaction: $C_2H_6 \rightleftarrows 2CH_3$. For mixtures of ethane and steam the mechanism of the reaction is more complicated; the data obtained indicating the probability of a second-order reaction. H. E. T.

903. Pyrolysis of Baku Petroleum. S. Popov, T. Prokofeva and E. Ginsberg. *Azerb. Neft. Khoz.*, 1936 (4), 59–67.—The pyrolysis of naphthenic gas oil at 700° C. and a feeding velocity of 204 gms./hr. in a laboratory retort gives a maximum yield of 5·45% toluene fraction with an 8·8% yield of benzene fraction; coke formed was 0·8%. The aromatization of gas oil needs a higher temperature for a shorter duration. It is possible to increase the velocity of feed 2·83 times at 700° C. and lower the yield of aromatics only slightly. The curves of composition change of the products of pyrolysis show that some of the benzene is formed from its homologues. Experiments with Pickering ovens under varying conditions gave yields somewhat lower than those for the laboratory apparatus. Surakhany topped crude yielded about 10% more toluene than that from Bibi-Eibat, but the coke formation was excessive. The gas oil cuts from these crudes behave in a similar way. The composition of these cuts had little effect on the yields. Aromatization was increased by including in the pyrolysis charge fractions boiling below 200° C., and this is explained as being due to dehydrogenation of alkyl six member naphthenes. For. Petr. Techn.

904. Determination of the Condensate from Gas under Pressure. F. E. Titovskii. *Azerb. Neft. Khoz.*, 1936 (2), 104–108.—The amount of condensate obtained by compressing petroleum gas up to 15 atmos. can be determined by the equation:

$$y_a = \frac{Vn}{\frac{(LP)}{(Vp_a)} + 1}$$

where y_a = no. of mols. of hydrocarbon in the gas phase of the equilibrium system under existing working conditions, v_a = % by vol. of the corresponding hydrocarbon in the raw gas, L = no. of mols. of the hydrocarbons in the liquid phase of the system,

V = no. of mols. of the hydrocarbons in the gas phase of the system, P = pressure in the system and p_a = tension of the hydrocarbon vapour present in the gas at a given temperature of the system. When compressing the gas in excess of 15 atmos. the following equation should be used:

$$y_a = \frac{Vn}{\left(\frac{L}{VK}\right) + 1},$$

where K = equilibrium constant, which is the ratio $y^1 : x^1$ of the mol. concentrations of the vapour and liquid phases of the equilibrium system. The latter was found for hydrocarbons of the paraffin series to depend on the temperature and pressure in the system. For. Petr. Techn.

905. Germicidal Properties of Nitrogen Bases from Transformer-oil Extract. W. N. Axe, D. D. Henson, and V. T. Schuhardt. *Ind. Eng. Chem.*, 1937, **29**, 503.—An Edeleanu extract resulting from the SO_2 treatment of a transformer oil stock is known to contain a small amount of nitrogen bases. From an extract of this type the bases were extracted by means of sulphuric acid, liberated with sodium hydroxide and vacuum-distilled into three fractions. These fractions were further extracted, in chloroform solution, with hydrochloric acid to separate the aromatic hydrochlorides (aqueous layer) from the non-aromatic hydrochlorides (chloroform layer). The liberated aromatic bases were distilled under reduced pressure into twenty-seven fractions. The anti-bacterial action of the various fractions of the transformer oil extract bases were examined by means of the cultures E. typhi and Staph. aureus. The bases were found to be insoluble in water and emulsions in soap solution possessed no germicidal activity. It was therefore necessary to dissolve the base in 0·1*N*-hydrochloric acid; the buffer action of the culture medium then precipitated the free base as a fine emulsion. Certain of the fractions examined possessed Food and Drug Administration Phenol Coefficients as high as 17. J. W. H.

Analysis and Testing.

906. Analysis of Mineral Oils. M. Steinbrecher and H. Kühne. *Oel u. Kohle*, 1937, **13**, 417–420.—A cold method of analysing oils, particularly those of high-boiling nature, is described in detail. The oil is separated into six chemical types—creosotes, olefines, aromatics, *cyclo*-olefines, naphthenes and paraffins—by means of selective solvents. 100 c.c. oil are shaken with 100 c.c. diethylene glycol which removes creosotes and olefines; the former are separated by treating the extract with 10% NaOH. The residue is shaken with three times its volume of diethylene glycol in the presence of SO_2 in order to remove aromatics. The residue after this treatment is treated with glacial acetic acid to remove traces of water, and is shaken with αα-dichlorhydrin which extracts the *cyclo*-olefines.

Naphthenes and paraffins are difficult to separate, but best results are obtained by shaking the residue with an equal volume of benzyl alcohol.

This method of analysis has the advantage over those employing sulphuric acid in that the formation of polymers and condensed products is avoided. P. G. H.

907. Composition of Light Oil for High-Speed Diesels. K. Yamazaki and S. Ota. *J. Fuel Soc. Japan*, 1937, **16** (173), 17.—Comparing the methods proposed (Griffith, Danaila, Sulphuric acid methods, etc.) for analysing gas oils the authors conclude that sulphuric acid of properly selected concentration gives the most reliable results. They recommend the use of 2 vols. of 90% acid to determine unsaturates and 2·5 vols. of 96% acid to determine aromatics. Samples of eleven oils on the market were analysed in this way and shown to contain small proportions of unsaturates and major proportions of naphthenes and paraffins, particularly the latter.

G. R. N.

908. Measurement of High Viscosity. R. N. Traxler and H. E. Schweyer. *Proc. A.S.T.M.*, 1936, **36**, Part II, 518–530.—Details are given of a number of instruments

for the determination of viscosity, in absolute units, of materials of high viscosity. The instruments include a capillary tube viscometer for measurement of viscosities ranging from 10 to 1,000,000 poises, an alternating stress apparatus for bituminous materials of 1,000,000–100,000,000 poises, a rotating concentric cylinder viscometer and a falling coaxial cylinder viscometer. A modified apparatus of the latter type has been adopted as a laboratory control instrument for the rapid measurement of viscosity of materials ranging from 5000 to 1,000,000,000 poises. A. O.

909. Determination of Mineral Oil in Tissues of Plants Sprayed with Emulsions. Z. M. Eidelman and N. G. Novikova. *Plant Protection* (*U.S.S.R.*), 1936, **8**, 66.—A cut of tissue placed on a slide is treated with 0·1*N*-caustic soda for 20 minutes, washed with water, dyed with a solution of thionine for 1 hour, washed with water again, then with 1 : 1 alcohol–acetone mixture and treated with "fatty red AT" dye for 1–3 hours. If this dye precipitates on drying, then the cut should be washed immediately with 1 : 3 glycerine–water mixture. The cuts are placed in glycerine. After this double dyeing red-coloured mineral oil drops may be observed. According to an alternative method, the cuts, after treating with 1 : 1 alcohol-acetone, are dyed with methyl violet in the presence of 2% acetic acid for 1·5 hours, washed with water and dyed with "fatty red AT" for one or more hours. In both cases drops of mineral oil are dyed red and the cells a placenta blue. The penetration of oil emulsions into tissues is discussed. For. Petr. Techn.

Motor Fuels.

910. Patents on Motor Fuels. G. W. Johnson. E.P. 463,742, 6.4.37. Production of non-knocking motor fuel by treating benzine, which has been divided into several fractions of different boiling ranges, with acetonitrile.

Texaco Development Corpn. and A. H. Stevens. E.P. 464,055, 12.4.37. Stabilization of ethyl fluid against deterioration on storage by adding 1–15% of lecithin cresylic acid.

Universal Oil Products Co. E.P. 464,753, 19.4.37. Catalytic refining of cracked gasolines by contacting them with a calcined mixture of pyro- or ortho-phosphoric acid and a solid absorbent at 180–400° C.

International Hydrogenation Patents Co., Ltd., R. M. Deanesley, E. C. Williams and L. V. Steck. E.P. 465,459, 3.5.37. Fuel consisting of a mixture of 65% of *iso*-octane, 15% of *iso*pentane and 20% of *iso*dodecane.

M. P. Youker. U.S.P. 2,076,013, 6.4.37. Combined stabilization and gas conversion process.

J. M. Smith. U.S.P. 2,076,519, 6.4.37. Production of high octane spirit from naphtha by distillation with *o*-toluidine and recovering the first overhead fraction.

M. S. Kharasch. U.S.P. 2,076,581, 13.4.37. Refining gasoline with 1–5% of substantially anhydrous HF to polymerize mono-olefines.

J. K. Roberts and P. C. Keith, Jr. U.S.P. 2,077,344, 13.4.37. Recovery of hydrocarbons from a gaseous mixture by absorption.

E. R. Smoley. U.S.P. 2,077,494, 20.4.37. Refining of cracked spirit by passing the vapour at 550° F. and under pressure (in the absence of added O_2), through a solid absorbent material to polymerize unsaturated hydrocarbons.

C. Ellis. U.S.P. 2,077,994, 20.4.37. Dehydrogenation of pressure-cracked petroleum in the presence of air at 400–600° F. and under pressure to produce aromatic motor fuel.

W. M. Stratford. U.S.P. 2,078,468, 27.4.37. Refining of cracked naphtha distillate by heating with sodium to 800–900° F. and under 1000–2000 lb. pressure per sq. inch. W. S. E. C.

Gas Oil, Diesel Oil and Fuel Oils.

911. Diesel Fuels and Lubricants. Anon. *Petr. Times*, 1.5.37, **37** (955), 573.—Diesel fuels are now, almost exclusively, of the distillate type, and considerable progress has been made in their specification and testing. Ignition quality is of prime importance, and is best indicated by some form of engine test. The cetene number is the generally accepted criterion, and is determined in the C.F.R. engine. Recent comparative experiments have indicated, however, that the Gardner engine, or a modification of it, may be more suitable as a standard testing unit than the C.F.R. engine. Attempts to find a more easily and cheaply applied indication of ignition quality have achieved only moderate success. Spontaneous ignition temperatures have been found to be somewhat unreliable, especially with fuels of non-petroleum origin. Heinze and Hoff have suggested that the correlation between cetene numbers and various physical properties which have been suggested previously as measures of ignition quality was closest in the case of the specific parachlor (*i.e.*, $\frac{\sigma^{\frac{1}{4}}}{d}$ where σ = surface tension and d = density), diesel index $\frac{(\text{aniline point} - {}^{\circ}\text{sF.} \times \text{A.P.I. Gravity})}{100}$ and viscosity – density constant (A in the equation $G = 1{\cdot}082\ A - 0{\cdot}0887 \times (0{\cdot}776 - 0{\cdot}72\ A)$ (log log $(KV - 4)$), where G = specific gravity at 60° F. and KV = kinematic viscosity in millistokes at 100° F.). The following is a suggested tentative specification for a high-speed diesel fuel.

Cetene No.	> 50 (or, alternatively aniline point > 60° C.).
Viscosity Redwood I. at 100° F.	30–45 secs.
Sulphur Content . . .	< 1%.
Ash	< 0·01%.
Water	< 0·05%.
Carbon Residue (Conradson) .	< 0·2%.
Hard Asphalt	< 0·1%.
Pour Point	At least 10° F. below lowest operating temperature.
Distillation Range . . .	The oil should be a wholly distillate oil with not less than 85% distilling below 350° C.

The diesel engine makes particularly heavy demands on the lubricating oil. Conditions are particularly severe at the beginning of the power stroke, when conditions of boundary lubrication obtain for a short distance of the piston's travel. A high degree of "lubricity" is therefore required, a demand sometimes at variance with stability under engine conditions. The first demand to make of a lubricant, therefore, is that it shall be capable of efficient lubrication without the building up of adverse decomposition products. The chief attributes of the oil may be summed up as follows:

1. High oxidation and thermal stability.
2. High lubricity.
3. Correct effective viscosity.
4. Low frictional loss at all temperatures.
5. High viscosity index.
6. Good sealing value.

The application of the principles of solvent refining is a notable step forward in the production of suitable lubricants. H. G.

912. Patents on Fuel Oil. R. Z. Williams. U.S.P. 2,076,392, 6.4.37. Dehazing furnace oils by treating them with dilute caustic soda solution at 180–210° F.

R. L. Savage, Jr. U.S.P. 2,078,882, 27.4.37. Preparation of fuel oil from acid oil sludge obtained from the treatment of mineral oils. W. S. E. C.

Lubricants and Lubrication.

913. Lubricating Properties of Lime-Base Greases. F. H. Rhodes and T. E. Wannamaker. *Ind. Eng. Chem.*, 1937, **29** (6), 763.—The following conclusions were reached

from a study of the effects of the concentration of soap (10–20%), water (1–5%) and free oleic acid (0–4%) on the static coefficient of friction of greases prepared from a viscous paraffin-base oil (64 secs. Saybolt at 210° F.) and calcium oleate: (1) At low temperatures the greases have lower lubricating values than the oil alone, at higher temperatures the greases are the better lubricants. (2) At relatively low temperatures the lubricating power increases with increase in the water content; at higher temperatures the frictional coefficients of all the greases examined approached the same low value. This value is reached at lower temperatures with increasing water content. (3) The addition of oleic acid improves the lubricating power at low temperatures, but decreases it at higher temperatures. J. W. H.

914. Lubrication Requirements of 1937 Rear Axles and Transmissions. G. C. Mather. *Petroleum Marketer*, 1937, **20** (9), 16–18.—The development of the hypoid gear is traced, and reasons for the variations in test results obtained on different laboratory machines are advanced. Some of these reasons are differences in materials and finish of test specimens, rubbing velocities and method of applying load. Service results under appropriate load are claimed to be the only safe guide to effectiveness. Coasting down hill in second gear using the engine as a brake sets up the most arduous conditions, it is stated. The requirements of both mild and the stronger hypoid type of E.P. lubricants are given, and these include stability under heat and in storage, freedom from chemical and abrasive action, etc. It is claimed that the mild type has hitherto been mainly successful because only a small part of the operating time is spent under maximum load conditions. For adequate safeguard against maximum possible load the claim is advanced that of all types available at the present time, the carefully controlled lead-soap, active-sulphur combination is alone effective. The theory is put forward that at the very high temperatures likely to be encountered, the lead soap and sulphur interact to form a flux preventing the welding action, commonly called scuffing or scoring. Because of these high temperatures, conditions tending to deteriorate the oil are more severe, and the lubricant should be changed every 5000–6000 miles. Flushing should be carried out with the proper oil, never with kerosine. Over-drive transmissions are taken care of by pure mineral oils, as even mild E.P. lubricants tend to oxidize and render the device inoperable. J. L. T.

915. Patents on Lubricating Oil. Standard Oil Development Co. E.P. 463,905, 8.4.37. Method of recovering selective solvents in extraction process.

N.V. de Bataafsche Petroleum Mij. E.P. 464,175, 3.4.37. Removal of wax and asphaltic substances from petroleum and products.

Ruhrchemie A.-G. E.P. 464,393, 12.4.37. Improvement of lubricating oils by the addition of polymerization products obtained by treating gases containing ethylene and propylene below 0° C. with polymerizing agents, *e.g.*, aluminium, zinc or iron chlorides resp., or boron fluoride.

F. L. Smith. U.S.P. 2,075,871, 6.4.37. Removal of odour from lubricating oils, wax, etc., by agitating with air at 130° F. and adding a demulsifying soap and soda.

W. H. Volck. U.S.P. 2,076,105, 6.4.37. Solvent extraction of lubricating oils, using as solvent a mixture of acetone and triethanolamine.

L. D. Jones. U.S.P. 2,076,147, 6.4.37, and R. E. Wilson 2,077,656, 20.4.37. Dewaxing systems for hydrocarbon oils.

J. Farwell. U.S.P. 2,076,498, 6.4.37. Dehydrating electrical insulating oils.

J. W. Poole. U.S.P. 2,077,057, 13.4.37, and M. H. Tuttle, 2,077,287, 13.4.37. Apparatus for solvent refining hydrocarbon oils.

J. K. Roberts and M. T. Carpenter. U.S.P. 2,077,712, 20.4.37. Propane dewaxing of hydrocarbon oils.

C. E. Lauer. U.S.P. 2,077,762, 20.4.37. Lubricating oil for journal-lubrication consisting of a blend of dewaxed paraffin base residuum and distilled paraffin base lubricating oil.

L. G. Story. U.S.P. 2,077,781, 20.4.37. Preparation of synthetic lubricant from chlorinated cracked products from paraffin wax.

E. R. Wiles. U.S.P. 2,078,186, 20.4.37. Refining of mixed base mineral oil using ethylene dichloride.

C. C. Miller. U.S.P. 2,078,403, 27.4.37. Countercurrent contactor for lubricating oils.

L. A. Clarke. U.S.P. 2,078,442, 27.4.37. Solvent refining of hydrocarbon oils using as solvent methoxy, β-methoxy or ethoxy-methylacetate or β-ethoxyethylacetate.

C. W. Troxell. U.S.P. 2,078,818, 27.4.37. Apparatus for reclaiming used crankcase oils. W. S. E. C.

Asphalt and Bitumen.

916. Effect of Mineral Fillers on Serviceability of Coating Asphalts. O. G. Strieter. *Proc. A.S.T.M.*, 1936, **36**, Part II, 486–493.—Details are given of an investigation of the effect on the weathering properties of the addition of mineral fillers to bitumen used in coating roofing felt. Mixtures were prepared with a series of fillers and varying amounts of two bitumens of 194° F. and 225° F. softening point to give blends of 225° F. softening point with 15%, 25% and 35% of filler. The weathering properties of the mixtures were examined by exposure outdoors and in an accelerated weathering test of aluminium panels surfaced with the mixtures. It is concluded that the weathering properties are improved by addition of filler, the extent of improvement differing with different fillers. An exposure of 30 cycles in the accelerated test was found to be equivalent to 1½ years' exposure outdoors. Properties of the fillers and mixtures and results of tests are tabulated. A. O.

917. Heterogeneity of Asphalt. G. L. Oliensis. *Proc. A.S.T.M.*, 1936, **36**, Part II, 494–517.—The significance of the "spot" test is discussed in the light of further experience with this test. It is pointed out that distinction between homogeneous and heterogeneous bitumens is arbitrary and depends on the use of a carefully standardized procedure. The test was submitted as a method of identifying petroleum bitumens which have been subjected to temperatures higher than normal in ordinary steam-refining and vacuum processes, and is not a test of quality. Heterogeneity has also been found to be due to waxy bodies, acid sludge bodies, combinations of incompatible fractions in synthetic bitumens and exposure to air. Heterogeneity can be corrected by blending the bitumen with Gilsonite or other highly homogeneous bitumen. When testing cut-back bitumen the solvent should be removed by distillation and the spot test applied to the residue. Details are given of a method, based on the addition of varying amounts of xylene to the standard naphtha, for the quantitative estimation of heterogeneity. In a contribution to the discussion of this paper results are given of spot test determinations on a series of 85/100 penetration bitumens before and after exposure in ⅛-inch films for 15 weeks, and also on residues from exposure of slow-curing liquid bitumens. A. O.

918. Susceptibility of Asphalts to Temperature Change. H. E. Schweyer, C. E. Coombs, and R. N. Traxler. *Proc. A.S.T.M.*, 1936, **36**, Part II, 531–543.—Methods of evaluating susceptibility of bitumen based on penetration, softening point relationships are criticized, and it is considered that changes in consistency resulting from changes in temperature are more satisfactorily expressed in terms of absolute viscosity. It is stated that at working and at service temperatures the log viscosity–temperature curve is a straight line, and for these ranges it is proposed that susceptibility be expressed as the percentage change of viscosity for 1° C. rise in temperature. Results for a series of bitumens show that the indices for the two temperature ranges differ in magnitude and the order of susceptibility may change. The susceptibility of a bitumen-filler mixture was found to be nearly the same as the bitumen. Viscosities were determined in the Saybolt Furol instrument at high temperatures and in a falling coaxial cylinder viscometer at temperatures of 15–35° C. A. O.

919. Increase of Viscosity of Asphalts with Time. R. N. Traxler and H. E. Schweyer. *Proc A.S.T.M.*, 1936, **36**, Part II, 544–551.—The article describes investigations into the effect of ageing on viscosity of bitumens. Various bitumens were examined in a series of falling coaxial cylinder viscometers at 25° C. after storage for various intervals. The results showed that the viscosity of bitumen increases if allowed to remain undisturbed at constant temperature, the increase being very rapid at first, but slowing up with time. On reheating, the bitumen is returned to its original viscosity, providing too long a period has not elapsed. The evidence indicates that the log viscosity–log time relationship is a straight line for periods up to 3000 hours and that age-hardening characteristics of a bitumen may be evaluated by observations up to 1000 hours. An asphalt ageing index is proposed. Certain bitumens were found to harden more rapidly and extensively than others, and a blown bitumen behaved differently from steam or vacuum refined bitumens. The addition of mineral filler to a bitumen had little effect on the rate of hardening. A. O.

920. Compression Testing of Asphalt Paving Mixtures. R. Vokac. *Proc. A.S.T.M.*, 1936, **36**, Part II, 552–567.—The paper briefly reviews the development of methods of test of the physical characteristics of paving mixtures and describes two compression testing methods investigated by the author. A. O.

921. Application of Bitumen in Frame Buildings. H. Hille. *Oel u. Kohle*, 1937, **13**, 437–440.—The special applications of bituminized paper, felt, and paints in the construction of frame buildings (wood or ferro-concrete) and methods of use are described. P. G. H.

922. Bituminous Finishes. H. W. Rudd. *Paint Manufacture*, 1937, **7** (3), 71–72 and 75.—Bitumen is an invaluable aid in combating corrosion and is available in finishes which can be divided into two general types: (*a*) those based on the solution of straight bitumen in volatile solvent, (*b*) those on a varnish or enamel basis containing bitumen in addition to the usual resin and oil. Both types contain metallic powders or the usual mineral pigments to mask the black colour of the bitumen.

Type (*a*) is limited in usefulness, as the films are apt to be brittle and prone to chipping, or else soft with little resistance to wear.

The metallic powders must be chosen so that they have the essential property of "leafing" satisfactorily, and so forming an attractive and impervious covering. Aluminium bituminous paints have remarkable protective properties, and will give a considerable measure of resistance to acids, sea-water, etc.

These paints may also be used as primers over metal work and as sealing undercoats over concrete.

In type (*b*) the incorporation of mineral pigments presents some difficulty, as the colour of the bitumen makes it impossible to produce really bright shades. The so-called "pale" bitumens are the best medium in this respect, but they seem to lack any considerable natural strength.

Bitumen has a retarding action on the drying of oils, and the addition of extra dryer is necessary. The choice of pigment is restricted, and only those of maximum staining power are suitable. It is often desirable to add small quantities of china clay or similar material to prevent settling of the pigment.

Dull reds, browns, grey, stone and dark greens are available, but so far no satisfactory blue has been produced.

Bituminous finishes, combining the water resistance of bitumen with the usual properties associated with enamels and metallic finishes, make an invaluable addition to the range of anti-corrosive preparations on the market. D. L. S.

923. Patents on Asphalt. N.V. de Bataafsche Petroleum Mij. E.P. 464,653, 22.4.37. Preparation of artificial asphalt by blending the asphaltic residue containing asphaltenes obtained from the oxidation of asphaltic oil with the extract from the solvent extraction of non-paraffinic hydrocarbons.

Standard Oil Development Co. E.P. 465,288, 5.5.37. Manufacture of artificial asphalt by fractionating a petroleum residual oil by means of solvents into fractions

containing high-boiling oil, resins and asphaltenes and incorporating the separated fractions in proportions suitable to produce asphalt of the desired physical properties.
W. S. E. C.

Special Products.

924. Indene-coumarone Solvent Oils. W. E. Sheehan, H. E. Kelly, and W. H. Carmody. *Ind. Eng. Chem.*, 1937, **29**, 576.—These new high-boiling coal-tar solvents are prepared from solvent naphtha by a regulated polymerization reaction which takes place in the presence of sulphuric acid and a catalyst. The crude product contains solvent naphtha, naphthalene, dicoumarone, di-indene and traces of higher polymers. The presence of a large quantity of concentrated sulphuric acid during the polymerization reaction results in the formation of large molecular aggregates. The various commercial grades of these aromatic oils are separated by distillation. They are viscous, chemically inert, high-boiling oils of exceptional all-round resistance, giving protection against alkalis, brine solutions and dilute acids. Their high solvent strength, low cost and low volatility make them particularly useful in chlorinated rubber coatings, lacquers, plastics, adhesives, fly-papers, inks, dyes and waterproof compositions.
J. W. H.

925. Paraffin Wax for Vegetable Preservation. Anon. *Petr. Times*, 8.5.37, **37** (956), 617.—The process, as applied successfully to turnips, consists of surface drying the roots by exposure to the air for 12 hours and then dipping rapidly into 121–123° m.pt. Paraffin Wax at 165° F. Unprotected vegetables lose 33–85% moisture in one month as against 1·9–12% for coated vegetables. Potatoes, cabbages, carrots and beet have been included in the experiment.
H. G.

926. Patents on Special Products. International Hydrogenation Patents Co., Ltd. E.P. 463,791, 1.4.37, and E.P. 463,851, 1.4.37. Production of *iso*-octane from olefines.

Universal Oil Products Co. and A. L. Mond. E.P. 464,752, 19.4.37. Alkylation of aromatic compounds by olefine hydrocarbons in the presence of phosphoric acid and a solid absorbent.

N.V. de Bataafsche Petroleum Mij. E.P. 464,952, 28.4.37. Production of mercaptans, thioethers or saturated hydrocarbons by the action of olefines and H_2S at 100–500° C. using as catalyst, iron, cobalt or nickel sulphides.

I.G. Farbenindustrie A.-G. E.P. 465,520, 3.5.37. Manufacture of polymerization products from trifluorochlorethylene.

Thiokol Corpn. E.P. 465,786, 13.5.37. Manufacture of plastic substances derived from mercaptans and mercaptides.
W. S. E. C.

Detonation and Engines.

927. Behaviour of Fuels in a C.I. Engine and a Rating Suggestion. D. Jafar. *Gas & Oil Power*, May 1937, **32**, 116.—To compare fuel behaviour in C.I. engines the following procedure was suggested: (1) Running conditions must be very nearly the same for all fuels, particularly speed, fuel injection, volumetric efficiency, air inlet temperature, cooling water outlet temperature. (2) Injection should be varied over a wide range, before and after T.D.C., and the delay period, knock and torque should be noted. (3) Injection timing should be retarded until the critical angle is reached, when the fuel ceases to fire regularly. This angle, designated as spontaneous ignition angle (S.I.A.), is defined as the angle between the retarded position of the injection at which the fuel ceases to fire regularly, and the T.D.C. It is thought that this angle may bear a relation to the quality of the fuel used so far as delay period and diesel knock are concerned.

In the Birmingham University a 4-stroke single-cylinder direct injection Tangye engine $4\frac{1}{8}$-in. diameter × $5\frac{1}{2}$-in. stroke, running at 1200 r.p.m. was used. Injection timing was measured by means of a neon tube indicator. Commencement of

combustion was measured by means of a Metrovick–Dodds cathode-ray electrical indicator. Delay period was taken as the time between the opening of the nozzle valve and the commencement of pressure rise due to combustion. Torque was recorded by means of a Heenan and Froude hydraulic dynamometer direct coupled to the engine. Diesel oil, kerosine, gasoline of 74·7 octane number and a leaded gasoline of 80·5 octane number were tested. Curves are presented to show the relation between (1) delay period and time of injection of each fuel, (2) torque and time of injection. An out-of-phase (90°) diagram shows the roughness when running on 74·7 octane gasoline. The S.I.A. of the four fuels tested were: diesel oil — 12·5°, kerosine — 10·5°, gasoline — 6·0°, leaded gasoline — 5·5°. The smallness of the range may be overcome by increase in compression ratio and selection of an engine sensitive to fuels. The indicator diagram shows the existence of a wave set up inside the combustion chamber when the engine was knocking badly. The velocity of this wave corresponded very nearly to the velocity of sound inside the chamber. Determination of the S.I.A. seems to offer a simple method of rating fuels, and the work at Birmingham will probably be continued. R. A. E.

928. Observations on Cylinder-bore Wear. M. M. Roensch. *J.S.A.E.*, 1937, **40**, 89–96.—The causes of cylinder bore wear are analysed, and the author finds the order of importance to be abrasion, erosion and corrosion, but points out that the conditions of operation, engine design, air-cleaner design, piston and ring design, and lubricant used are variables which may quite easily change the order completely. Details are given of several series of tests on various engines which show the effect of varying piston-ring equipment on wear, consumption, static friction and blowby. The effects of air cleaners and different water-jacket designs are also dealt with. It is contended that a major cause of scuffing is from erosion during the warm-up period, when the expansion of the pistons while the jacket is still cold causes abnormal pressures between pistons and cylinders. Photographs showing the beneficial effects of anodizing and tin plating are reproduced. C. H. S.

929. Mechanism of Carbon Formation. A. Maillard and M. W. Edelberg. *Ann. des Comb. Liq.*, 1936, **11**, 1117–1126.—Using hydrogen as fuel for a small single-cylinder motor-cycle engine, the carbon formed was of a hard, adherent nature, different from that normally observed in I.C. engines. Estimation of CO and CO_2 in the exhaust gases was used to derive the amount of oil consumed by combustion. This is considered to be only 10% of the total consumption, so it is concluded that mechanical losses account for the bulk of oil consumption. Within the limits of experimental error there was no difference in the amounts of carbon formed from "new" or from "used" oil, but the "used" oil showed a greater tendency for combustion as indicated by the rise in the amount of CO_2 in the exhaust gases. Exploratory tests using petrol as fuel showed that the deposit was less hard than when hydrogen was used, and moreover had a tendency to scale. As the mixture was enriched the deposit did not increase, whilst with an extremely rich mixture the deposit was light and powdery, due, it is considered, to the washing action of the fuel. It is concluded that carbon formation is more a question of carburation than of the quality or age of the lubricating oil. J. L. T.

Coal and Shale.

930. Coal-Oils Technology. Recent Developments in the Direct-Solution Method. Anon. *Chem. Trade J.*, 21.5.37, **100**, 449.—A second plant is to be erected at the mines of the Gewerkschaft Mathias Stinnes for the production of coal-oils by the Pott-Broche solvent extraction process. The method is also being considered in Italy as a practical alternative to the direct coal hydrogenation and Fischer Tropsch processes. The original process described in E.P. 293,808 covered a method of obtaining coal extracts, whereby solid fuels are treated with suitable solvent media which boil above about 100° C. in the absence of hydrogen, under pressure and at temperatures corresponding to the decomposition temperatures of the coal material present in the extraction. The crude reaction product is a homogeneous solution of the coals in the oils, in which undissolved residual and ash-enriched portions are

suspended in a state of the finest division. To obtain ash-free extracts, the ash and residual coal must be separated off before distilling off the solvent, and it is understood that in practice considerable difficulties arise owing to the extreme fineness of the residual coal to be separated. E.P. 464,337 gives an indication of the method whereby this difficulty has been solved. The crude coal disintegration product is subjected to filtration at elevated temperatures. It has been found advisable to use the filter cakes forming out of the residual coal as filter material, and to employ as support wire nets with a mesh width somewhat greater than the granule size of the separated residual coal; limits of 0·1 mm. to 2 mm. are mentioned.

In this way smooth, complete and rapid separation is claimed, the ash content of extracts after removal of solvents being usually less than 0·1%. Temperatures of 150–170° C. have proved suitable, and the filtration excess pressure usually amounts to 10–20 atmos. Other operating details are given.

To remove the last traces of ash from the coal extracts, acid washing of the hot solutions may be employed. Aqueous hydrochloric of 30% strength may be used, and the acid washing repeated and followed by a water wash. After removal of solvent, an extract of 0·02% ash content is obtained. It is thought that when extraction agents containing phenols, cresols, etc., are employed, phenolates, etc., go into solution. Acid treatment removes the inorganic constituents combined with the phenolic constituents. R. A. E.

931. Action of Aqueous Alkali on Bituminous Coal. L. Kasehagen. *Ind. Eng. Chem.*, 1937, **29**, 600.—On heating at elevated temperatures and pressures in the presence of aqueous alkali a bituminous coal is converted into coke-like residues which have a lower percentage of oxygen and hydrogen than the coal itself. Neutral viscous liquids and solid phenolic substances of high molecular weight are by-products of the treatments. By the selection of suitable conditions, residues which have hydrogen percentages as high as, but oxygen percentages much lower than, those of the coal can be formed. Hydrogenation of these residues forms products more hydrocarbon-like in nature than does the similar hydrogenation of the coal itself. J. W. H.

932. Patents on Coal. J. L. Strevens and W. B. Mitford. E.P. 465,047, 26.4.37. Carbonization of coal–oil mixtures at atmospheric pressure in a cylindrical retort—adding a 10% solution of caustic soda before introduction to the retort.

E. Blümner. E.P. 465,067, 30.4.37. Extraction and subsequent carbonization of bituminous coal. W. S. E. C.

Economics and Statistics.

933. Arguments for Oil Prospecting in France. C. Baron. *Rev. Petr.*, 7.5.37 (734), 601–605.—The author, the President of the Commission of Mines, states that little help has been given by the Government up to the present, whereas elsewhere in Europe extensive financial subsidies have been made. Germany, as a result, is able to supply 45% of her oil requirements, whilst still keeping some wells in reserve, which would probably bring the percentage to 66%, for possible emergencies. The economic possibilities of obtaining light spirits from wood-charcoal, coal, lignite and oil shale are discussed. Emphasis is laid on the need for further geological search for oil; little work has been done except at Pechelbronn and Gabian, and even there further investigations should be carried out. In the near future some wells are to be drilled in Savoy and 25,000,000 fr. are to be spent on geophysics, geology and drilling elsewhere. In view of the excellent geophysical work done by the French elsewhere, it is curious that the geophysicists have received no assistance in France. The legal aspect of the situation is also discussed. R. O. Y.

934. Reported Hungarian Oilfield. Anon. *Petr. Times*, 29.5.37, **37** (959), 705.—This article refers briefly to exploratory wells drilled near Mihalyi in N.W. Hungary, Kaposvar and Inke in S.W. Hungary, and near Lispe, a mile north of an earlier well near Budafapuzsta. Oil prospects at Buekksek and in the Szentadorjan district, thought very promising at one time, have now been modified to about 4000 tons per annum. A. J. H.

935. Will New Guinea become an Oil Centre? Anon. *Rev. Petr.*, 21.5.37 (736), 663.—Now that New Guinea has been partly surveyed and some communications have been established, arises the question of search for oil. The greater part of the British mandated territory is to be the subject for search, for which the Australian Government is contributing £250,000. While up to the present only a small part of the island has been searched, indications from seepages and structures point to New Guinea as being as important a producer as the Dutch East Indies. Geological work began last November, and will continue for some time. R. O. Y.

936. Oil Imports into Greece. N. Manesco. *Mon. Petr. Roum.*, 1937, **38**, 697-701.—Total imports of petroleum products into Greece were 244,000 metric tons in 1935 and 280,500 metric tons in 1936. Roumania's contribution fell from 177,600 tons (72·6%) to 76,670 tons (27·3%). The decreases were 129,000 to 44,000 tons in mazout and 30,000 to 12,500 tons in petrol. Exchange and currency restrictions caused this collapse.

Payment in 1935 had to be made half in free currency ("devisen") and half in drachma bills guaranteed against devaluation by the Bank of Roumania. The heavy imports into Greece in 1935 were apparently not balanced by exports from Greece to Roumania. The bills could neither be cleared nor discounted, and thus the trade in oil products was seriously hampered. A new agreement for payments was made in April 1936, but it was not a success, and in October all currency restrictions were removed as regards imports from countries with a special clearing-house agreement, *i.e.*, Roumania, Russia, Germany and Belgium. Imports are controlled by the Minister of National Economy. Permission to import has to be sought for each consignment, and the permit lasts only a month.

America suffers from no restrictions on the amount of her exports to Greece or on the method of payment, and in spite of the distance and cost of transport, the American percentage of total oil products imported by Greece rose from 37% in 1935 to 70·4% in 1936.

The Bank of Greece has provided a credit of a few million drachmas to finance prospecting for oil in Greece. Prospects are apparently not very bright. The Government is considering the raising of the import duty on oil products, and also the assumption of monopoly rights for the import and sale. Refineries may well be established.

Duties at present are 832 drachmas per 100 kilograms of petrol (309% of value), 13½ dr. per 100 kgm. for heavy oil (9% of value), and 911 dr. per 100 kgm. for illuminating oil (498% of value). (About 550 dr. to the £.) W. E. J. B.

937. Economics of Treating and Inhibiting Gasolines. P. S. Nisson and W. B. Ross. *Oil & Gas J.*, 29.4.37, **35** (50), 56.—In assessing the cost of refining processes, one factor that has at times been almost entirely neglected is the degradation of one quality in processing the gasoline to attain another. This applies principally to the question of octane values and to the susceptibility to lead tetraethyl.

The treating of gasoline may be roughly subdivided into: 1. Obtaining proper colour, gum content, or stability of certain properties in storage by treatment with acid, absorbent or other material, or by addition of inhibitor, perhaps combined with such treatment. 2. Sweetening to impart satisfactory odour to the product.

The authors consider that treatment for odour has achieved an importance not entirely consistent with its real value, since there is almost complete elimination of contact of the motorist with the odour of the gasoline he is using, and the nature of this quality is debatable. Approximate comparative cost data given of processes mainly concerned with the first treating classification are:—

Process.	Equipment Cost.	Royalty.	Treating Cost.	Octane Loss.	Loss.
Inhibitors .	0·2	—	0·0026/0·0227	nil	nil
Gray . .	15/25	35	0·002/0·0057	<1	0·5/4%
Osterstrom .	22/40	35	0·0225/0·040	<1	0·5/4%
Lachman .	not given	not given	0·06	practically nil	1/3%
Acid. . .	15/20	—	0·025/0·045	2/3	2·5/4·5%

The equipment costs and paid-up royalties are quoted in dollars per brl. of daily intake capacity, and treating costs are quoted in dollars per brl. Acid treating involves redistillation, the cost of equipment for which ranges from $35 to $50 per brl. daily capacity. Merits and advantageous applications of the processes are discussed. For normal cracked stocks, where sulphur content is not very high, treatment without acid is possible. Costs and treatment losses naturally vary with the type of cracked gasoline requiring treatment.

Sweetening is usually achieved by doctor treatment, for which equipment cost is $10/20 per brl. daily capacity, treating cost $0·0082/0·0216 per brl., loss ranges from 0·1 to 0·75% and octane loss may amount to as much as three numbers. Treatment with caustic wash instead of doctor solution results in a reduction of about 50% of processing cost, and also eliminates octane loss and the increased antioxidant requirements caused by excess sulphur left in gasoline by doctor sweetening. Since a satisfactory product can be made by proper selection or combination of the refining processes mentioned, followed by washing with caustic solution, the authors find it difficult to justify doctor sweetening by any process.

Details of gum and induction period tests and cost of inhibiting various cracked and straight-run gasoline mixtures mainly of Mid-Continent origin are tabulated.

R. A. E.

938. Law for the Modification of Certain Articles of the Mining Law of March 28th, 1929. Anon. *Mon. Petr. Roum.*, 1937, **38**, 471–514.—The complete text of the 309 articles of the above law. T. C. G. T.

BOOK REVIEW AND BOOKS RECEIVED.

Book Review.

THE GEOLOGY OF SOUTH-WESTERN ECUADOR. George Sheppard. Pp. xiii + 275. Thomas Murby & Co., London. 25s. net.

The author's preface stresses that this book in no way replaces the work of Dr. T. Wolf, his predecessor in the office of State Geologist to the Republic of Ecuador, but is merely a supplement to the geology of a special region. It is believed to be the first volume on the geology of Ecuador to be published in English.

Some of the subjects dealt with are at present matters of controversy, and the author expects that many of his conclusions will meet with adverse criticism. His main object has been to place on record the geological information in the hope that it will provide some basis on which future students in this little-known field can work.

The author was faced with the difficulty of compressing into eight chapters, totalling 275 pages, general descriptive matter, geological evidence and his own conclusions. It would seem that he has somewhat sacrificed a logical consecution by embodying in the evidence arguments on controversial questions which have to be reiterated in part in chapter after chapter. His readers' interest would have been better maintained had the description of the observed evidence been freed of all argument, and this then summarized and given with his conclusions in a separate chapter.

The book abounds in intensely interesting matter. It starts with an account of the climate and physiography of South-Western Ecuador in recent times. The generally semi-arid western part of this area exhibits an extraordinary amount of recent erosion and denudation, as is shown in the remarkable surface configuration. Normal rainy seasons would not account for this, and it can only be attributed to periodic episodes of devastating rainfall. From this evidence of recent floods and from study of the sedimentation as seen in the Tertiary outcrops, the author arrives at his first important conclusion, that very similar climatic conditions prevailed in this region as far back as the beginning of the Tertiary epoch.

In Ecuador there are nearly 15,000 feet of Tertiaries. Such thicknesses point to very rapid deposition, but the general fine texture and level bedding of a large proportion of the Eocene deposits are indicative of slow accumulation. These two contradictory conditions, coupled with the poverty of the fauna and the admixture in the Seca shales of foraminifera and lignite, are difficult to reconcile. The author suggests three possible solutions of the problem:

1. Deposition in a deep trough off a high arid table-land.
2. Deposition in a series of lagoons under conditions unfavourable to life.
3. Deposition in an extensive estuary.

He favours the third theory, assuming close similarity between present climatic conditions and those throughout all Tertiary times within the regions west of the Ecuadorian Andes. He further maintains that there would be no difficulty in reconciling very rapid deposition with fine-textured beds showing level bedding, if it is assumed that Tertiary deposition is partly due to a series of huge mud-streams coming to rest in a large estuary and making a dejected fan of rapidly slumped material during cataclysmic periods. The Tertiary Clay Pebble Bed is believed to be another mud-stream.

In addition to this most interesting account of Tertiary sedimentation, there are other chapters on stratigraphy, structure, igneous rocks, and cherts. An excellent account of the Tertiary layer foraminifera found in the area is contributed by Dr. Vaughan, and there is a final chapter dealing with petroleum. In South-Western Ecuador there is an intimate geological association of oil sands with the known areas of igneous intrusions in the vicinity of which crush belts of pulverized areno-argillaceous

material are found, the most saturated oil sands occurring in the excessively shattered zones, often in contact with dykes. The author advances the hypothesis that the rise in temperature due to igneous intrusions caused a regional separation of the oil, which, after having originally been generated in the shales intercalated amongst the more sandy elements, later accumulated in the crush zones. In his opinion the oil had its origin in the silty shales making up the greater part of the Tertiaries, but, as the Oligocene is virtually non-petroliferous, the majority of the oil occurrences found higher than the Eocene are entirely due to upward migration along joint or fault planes.

The author has not only attained his purpose in supplying a basis for renewed research by future students of this region, but has also given much food for thought to all petroleum geologists on the puzzling problems of the genesis and behaviour of petroleum.

After indicating the great value and interest of this book, it seems a pity to criticize shortcomings in its final preparation. The most distracting defect from a student's point of view is the lack of correlation between the text and the maps. It is an old maxim that the text should never mention any place which is not shown on the maps. Instances of disregard of this maxim are very noticeable in studying this book. Again, the variation in the scales on the maps detracts from easy and quick reading, but the worst mistake noticed is seen on comparing Figs. 1 and 132. According to the scales of each map there are wide discrepancies between the positions of and distances between Ballenita and Santa Elena. More care might also have been given to the compilation of the bibliography of 204 items and of the main index. B. F. N. M.

Books Received.

Petroleum and Natural Gas Bibliography. R. E. Hardwicke. Pp. xii + 167. University of Texas Press.

This book, a compilation of copyrighted material recorded in the Library of Congress, together with items of general interest found elsewhere, forms a useful guide to the literature of petroleum and natural gas which has been published in the English language.

The Institution of Mechanical Engineers, Proceedings. Vol. 134, November–December 1936. Pp. xii + 593. The Institution, London.

Included in the papers published in this volume are a paper on "Some Factors affecting the Design of Heat Transfer Apparatus" by E. W. Still, and one on "The Measurement of Altitude and Eccentricity in Complete Clearance Bearings" by D. Clayton and C. Jakeman.

Annual Report of the Department of Lands and Mines of the Province of Alberta for the Fiscal Year Ended March 31st, 1936. Pp. 95. Published by order of the Legislative Assembly. Edmonton, Province of Alberta, 1937.

It appears that a noticeable increase in the development activity of the Province's oilfields was experienced during the year under review. Satisfactory results are expected from the operation of wells on the west flank of Turner Valley.

Report of the Road Research Board for the Year Ended 31st March, 1936. Department of Scientific and Industrial Research. Pp. viii + 136. Published by H.M.S.O., 1937. 2*s*. 6*d*. net.

In this report the Director of Research surveys the present position of road research with particular reference to materials, methods of road construction, road usage and the development of special testing apparatus.

U.S. Geological Survey:

Bull. 861. Geology of the Anthracite Ridge Coal District, Alaska. G. A. Waring. Pp. 57. 1936. Superintendent of Documents, Washington, D.C. 70 cents.

Canada. Department of Mines and Resources:

BULL. No. 780. PETROLEUM FUELS IN CANADA. DELIVERIES FOR CONSUMPTION, CALENDAR YEAR 1935. J. M. Casey. 1937. Pp. 20. Issued by the Bureau of Mines and Resources, in Co-operation with the Dominion of Fuel Board. King's Printer, Ottawa. 10 cents.

This pamphlet comprises data on deliveries of fuel oil, kerosine, gasoline and petroleum coke in Canada during 1935. It is shown that deliveries of petroleum products for fuel amounted to 1108 million Imperial gallons, consisting of 499 of fuel oil, 35 of kerosine and 574 of gasoline; about 80,000 short tons of petroleum coke were also delivered.

GEOLOGICAL SURVEY OF INDIA. Records of the Geological Survey of India. Vol. 72. Part I. 1937. Pp. 133 + 28. Manager of Publications, Delhi. 5*s*. 3*d*.

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH. Methods for the Detection of Toxic Gases in Industry. Leaflet No. 1. Hydrogen Sulphide. Pp. 4 + 6. H.M. Stationery Office, London. 1937. 3*s*. 6*d*. net.

The method of test adopted consists in drawing a known volume of the atmosphere under test through a piece of test paper treated with lead acetate specially fitted to a hand pump. The test paper becomes stained a brownish colour and concentrations of hydrogen sulphide from 1 part in 150,000 upwards can be gauged by comparing the colour of the stain with a carefully printed colour chart attached to the leaflet. Full instructions for carrying out the test under standard conditions are given.

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Geology.

939. Illinois Basin. J. M. Weller and A. H. Bell. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 771–788.—Consisting of two parts, this paper deals with a summary of the geological history of the Illinois basin with special reference to structure, and the exploration for oil in the territory.

Part I. Pennsylvanian rocks outcrop throughout most of the area, and underlying them is a thick and nearly complete succession of the older Palæozoic systems. All of these, particularly the Devonian, appear to thicken inward and southward in the basin. This thickening continues to the extreme southern limit of the basin, and here the Palæozoic rocks pass under the younger deposits of the Mississippi embayment. Thus, with the known age of the uplift bounding the basin on the south, it is proved that the present Illinois basin is only part of a larger depression which during Palæozoic time extended an unknown distance southward.

The past important uplift occurred towards the end of the Palæozoic era or possibly early in the Mesozoic. The youngest Pennsylvanian beds were then involved, and the area was subsequently peneplaned and overlapped from the south by late Cretaceous sediments of the Mississippi embayment.

Other important structures in the basin are discussed and illustrated by maps and sections.

Part II. In a review of the exploration for oil in Illinois reference is made to three periods in its history: prior to 1905, 1905–1934, and 1934 to date.

The first of these periods saw only a small economic production of oil. The second included the discovery of the S.E. Illinois field, which reached a production peak of nearly 100,000 brls. per day, and which to date has produced more than 415 million barrels from 92,000 acres. During 1934 (the third period) detailed surface geological work was begun by the Carter Oil Co., and this has resulted in the present activities by other companies. Seismographic surveys also began during this time, and now (March 1937) eleven parties are operating: nine in Illinois and two in the adjacent part of S.W. Indiana.

A fact of much interest concerning recent discoveries is that the first three wells in Illinois located by means of seismograph surveys have all produced oil in commercial quantities.

A stratigraphical column is given showing the principal producing horizons in the States of Illinois and Michigan. These, in order of importance, are: Pennsylvanian Sands, Chester (Upper Mississippian) Sands, Lower Mississippian Limestones, Devonian Limestone, Trenton Limestone and St. Peter.

Approximate figures of the total production to 1936 from the various systems are: Pennsylvanian 60%, Mississippian 39%, Devonian and Ordovician 1%. G. S. S.

940. Stratigraphy of Sundance Formation and Related Jurassic Rocks in Wyoming. J. Neely. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 715–770.—An attempt is here

made to throw light on the problem of correlation of the Jurassic rocks of S.E. Idaho section, N.W. Wyoming, and the marine representatives which occur over much of the remaining parts of Wyoming (the Sundance formation). Attention is first directed to previous investigations of Jurassic deposits in Wyoming, and this is followed by a general account of the characters and distribution of the formations themselves.

These formations—in addition to the Sundance—are the Nugget, Twin Creek, Preuss, Stump, and Ellis, and consist mainly of sandstones with some limestones. While brief descriptions are given of each of the latter, chief consideration is devoted to the Sundance. This formation, which rests unconformably on Triassic rocks and is overlain unconformably by the Morrison, has been divided into an upper and a lower series. It consists of a basal sandstone, red shales and sands, and fossiliferous dark marine shales with limestones.

The following correlations are made: (1) the Nugget may be equivalent to the basal sandstone (Sundance formation) in the vicinity of the Freezeout Hills (S.E. Wyoming); (2) the Twin Creek is in part equivalent to the Ellis (N.W. Wyoming) and to the lower portion of the Sundance in Central and Eastern Wyoming; (3) an erosional interval within the Sundance, the erosion corresponding with the period of withdrawal of the Twin Creek Sea; (4) the upper portion of the Sundance is equivalent to the Preuss and Stump of Western Wyoming and S.E. Idaho and the upper portion of the Ellis of N.W. Wyoming.

Of the ninety-nine oil-producing fields in Wyoming, seventeen occur in the Sundance formation. Production is obtained from anticlinal structures lying in a belt a little over 100 miles broad which trends along, and is parallel to, the old shore-line of the Twin Creek and Logan (Sundance) seas. Theories accounting for accumulation are: (1) Palæo-biochemical relationships; (2) "Up-dip" migration before late Cretaceous folding took place; (3) porosity control by the coarser-textured sandstones deposited near the shore. G. S. S.

941. Oil and Gas Possibilities in N.E. Arkansas and W. Tennessee. W. P. Jenny. *Oil Weekly*, 5.7.37, **86** (4), 26, 28, 30–32.—Attention has been attracted to the area under consideration at various times in the past, and numerous shows have been reported in wells and on the surface. Of test wells drilled, some have reached and a few have penetrated the Palæozoic floor which forms a trough parallel to the Mississippi. A normal section above the Palæozoic near Memphis comprises 1000 ft. of Upper Cretaceous, 500 ft. of Midway and 1500 ft. of Wilcox, these formations thinning out with decreasing depth of the Palæozoic. A number of structures have been mapped in various districts. There are possibilities of a fault zone parallel to, and about 5 miles east of, the Mississippi which might be a governing factor in oil accumulation. It appears that a number of gentle structures may be found which should be tested. There should be considerable thicknesses of Pennsylvanian which has produced much oil and gas elsewhere, and the Chester (Lower Mississippian), Devonian and Ordovician formations represent possibilities of deeper production.

Detailed consideration is given to a regional magnetic map (insert) and to a magnetic and reflection picture of the Covington structure which exemplifies the type of local structure to be expected. It is emphasized that the most reliable results are to be obtained by combining the results of geological and geophysical methods. The combination indicates better prospects for the area than have been hitherto assumed. A. J. H.

Geophysics.

942. Micromagnetic Predictions are Proven by Drill. W. P. Jenny. *Oil Weekly*, 14.6.37, **87** (1), 110–111.—The magnetometer has been greatly improved, and it is now possible to make measurements with an accuracy of $\pm$ 2 gammas as compared with the earlier $\pm$ 10 gammas or $\pm$ 25 gammas. The basic assumptions for the interpretation of magnetic anomalies have also been changed. Not all the anomalies are due to basement or shallow igneous rocks, for variations in the magnetic susceptibility within the sedimentary column produce noticeable magnetic anomalies over structures of commercial significance. In the development of the northern extension of the Anahuac field, Texas, a micromagnetic map showed certain features which have been borne out by later drilling. G. D. H.

Drilling.

943. Directional Drilling Applied to East Texas Edge Wells. J. D. Hughes. *Petr. Eng.*, June 1937, **8** (9), 39.—As a means of avoiding the tight or highly impermeable areas of slight saturation in productive sands directional drilling was tried in the East Texas field. The object of this test was to drill through the sand at a desired angle in order to increase the superficial area of the sand in the hole.

Tables are given to show the results obtained. L. V. W. C.

944. Gulf Coast Deep Tests Drilled through Heaving Shale. D. S. Sneigr. *Petr. Eng.*, June 1937, **8** (9), 37.—By the proper conditioning of mud and the use of heavy drilling equipment the problem of drilling heaving shales in the Matagorda County, Texas, has been solved.

The rig used consists of two engines, two draw-works, three mud pumps, five boilers, four mud-storage tanks and a battery of small open tanks for suction pits. The hook, swivel and block are all 300-ton test. The derrick is 136 ft. high and is mounted 14 ft. above the ground on a steel-and-concrete substructure. The derrick floor is approximately four times as large as the average derrick floor.

Three chemical engineers are employed working 8-hour shifts, and a laboratory has been set up at the well where all tests on the mud are made; tests are being made every 30 minutes for gel, viscosity and weight. L. V. W. C.

945. Drilling Practices—Rotating Speeds and Weight on Bit Receive Attention. B. Mills. *Oil Weekly*, 14.6.37, **86** (1), 50.—The speed of drill-pipe rotation and weight carried on the bit are closely related to drilling footage. The trend has been towards more rapid rotating speeds and reduced weight on the bit, but theoretically it is impossible to determine either the rotating speed or weight that should be applied to any given formation. When hard formations predominate it has been found in several districts that high speeds are not so effective as low speeds. Light weight on the bit with low speeds gave the best results. With excessive speed the bit wore out without cutting the formations.

Hard formations that show a tendency toward brittleness may be drilled successfully at very high rotating speeds. Rotating speeds vary from 75 to 250 r.p.m., the best speed depending on a number of factors.

The effects of mud volume and pump pressure are pronounced, and must be considered together with speed and weight. L. V. W. C.

946. Development of the Mason Field. J. A. Kornfeld. *Petr. Eng.*, May 1937, **8** (8), 116.—Among the difficulties that had to be overcome in drilling the new West Texas field, Mason field, were heaving sand, loss of circulation in cavernous lime and low-pressure formations. Sweet crude oil of high gravity and favourably high allowables have attracted attention to this area.

Diesel rotary drilling is a feature of the development. L. V. W. C.

947. Deep Development Practice in Jennings Field, Louisiana. J. A. Kornfeld. *Petr. Eng.*, June 1937, **8** (9), 74.—The wells of the Coastal Louisiana area have massive concrete cellars and foundations, and extremely heavy drilling equipment is employed.

Drilling practices include the use of separate rotary table drive and the installation of double draw-works to reduce shutdowns.

Both gun perforation of casing and perforated liners are used. L. V. W. C.

948. Deeper Drilling in N. Louisiana Presents Unique Problems. M. Tucker. *Oil & Gas J.*, 29.4.37, **35** (50), 44.—The development of the Cotton Valley field, North Louisiana, has presented many unique and difficult problems not met with in other areas of this state.

The 8000-ft. wells require about 90 days' drilling time, as opposed to 30 days elsewhere. Rock-bits are used throughout, and even these find great difficulty in penetrating the Travis Peak section from 6000 to 7200 ft.

Mud problems are twofold, and mud screens and shakers are absolutely necessary. The mud is kept at about 9½ to 10 lb. per gal. with a viscosity of from 20 to 21·5 down to 7200 ft.; below this considerable weight material is added to combat the 800-ft. gas sand. The bottom-hole temperature at this depth is about 190° F., and this seriously affects the mud consistency. L. V. W. C.

949. Use of Wire-line Core Barrels in California. W. A. Clark. *Petr. Eng.*, May 1937, **8** (8), 70.—Wire-line core barrels have been in use since 1926, but the results obtained were unimpressive, and the development of the tool was therefore slow. By the end of 1936, however, 130,000 ft. of hole had been cored by this method.

Data show that the tool is most economical in use in wildcat wells, intermittent coring and in deep wells. Its use in shallow wells depends on the formations to be dug. It has not eliminated conventional coring, particularly in shallow wells, or in wells from which only a few cores are to be extracted and which do not justify extra equipment. L. V. W. C.

950. Rotary Drill Cuttings Important Guide in Exploration Programmes. P. Reed. *Oil & Gas J.*, 6.5.37, **35** (51), 42.—An important factor in the discovery of new oil supplies is the microscopic examination of drill-cutting samples. The taking of samples is a recognized part of drilling operations and the intensive search for new fields has resulted in more attention being directed to the significance of the samples.

A discussion of the practice as applied to the Mid-Continent is given. L. V. W. C.

951. Methods of Catching Rotary-Drill Samples in Oklahoma. P. Reed. *Oil & Gas J.*, 10.6.37, **36** (4), 42.—The importance of sample logs and their possibilities has been emphasized since the discovery of the East Texas field, and in the search for large fields which can occur as the result of stratigraphic conditions sample logs may furnish important clues.

Sampling methods must be suited to conditions, and a number of practices of sample catching are carried out at the Oklahoma drilling wells. Among these the most common are: box with removable weir placed above the flume and mud flowing in through a pipe at an angle; box placed at an angle and at approximately the same level as the flume, and box under flume, receiving part of the mud through a hole in the box.

The various methods are considered. L. V. W. C.

952. Specialization of Equipment Distinct Trend in the Past Year. F. B. Taylor. *Oil Weekly*, 14.6.37, **86** (1), 125.—Matched rig set-ups have shown advance, and the driller is able to choose from more than thirty units to-day which have been specially designed to meet certain conditions of strata and depth.

More exhaustive analyses of prime movers have been carried out, with the result that new designs of particular merit are now available. Steam rigs working at pressures nearly twice those generally used have been constructed, and conservation of steam and the utilization of all generated pressure, plus successful superheating and preheating have made these units both flexible in operation and economic. New types and designs of internal-combustion power units have been successfully adopted.

Alloyed materials have assisted in the general improvement of all kinds of oilfield equipment. L. V. W. C.

953. Cause and Effect of Frozen Drill-Pipe and Casing. J. T. Hayward. *Oil Weekly*, 7.6.37, **85** (13), 7; *Oil & Gas J.*, 3.6.37, **36** (3), 42.—Laboratory apparatus and tests are described which show that stuck pipe can be freed by alternately starting and stopping the pumps. Experiences are stated where these means have been used successfully in the field. Tapping the pipe lightly while it is under tension has also been found effective, and tapping by means of water hammer has proved this contention in the field.

Other causes and cures for frozen pipe are described. L. V. W. C.

954. Coring Increased and Improved. E. S. Post. *Oil Weekly*, 14.6.37, **86** (1), 64.—The need for more and accurate subsurface information has resulted in more attention being given to logging and coring. Many new devices for exploring the lower strata have been devised. Core laboratory analysis, temperature determination, bottom-hole pressure tests, electric formation logging devices, instruments for determining points of water intrusion into coring, etc., have taken an important place in the industry.

The changes in the methods of coring are dealt with in detail. L. V. W. C.

955. Welded Joint Casing Run in Deep Oklahoma Well. L. G. E. Bignell. *Oil & Gas J.*, 29.4.37, **35** (50), 30.—With the running of 5968 ft. of 8¼-in. welded casing an advancement in well completion practices in the Oklahoma field is to be noted. This is the first flow string of welded casing to be run in the Mid-Continent. The casing used was of the butt-welded type and the U-shaped grooves for the welding metal were cut at the factory.

Electric welding was used, and at all times there were four welders at work, and the job was carried on continuously day and night. Each weld required about seven minutes, including hoisting and lowering the pipe.

The whole job was completed in twenty-seven hours. L. V. W. C.

956. Use of Light-weight Surface Casing in Mid-Continent. L. S. Allen. *Oil & Gas J.*, 29.4.37, **35** (50), 61.—There has been a marked increase in the use of light-weight welded surface casing in the Mid-Continent area. The lightness of the pipe and the improvements in welding technique have combined to effect its use. A wall thickness adapted to the requirements of different length strings is possible by the use of light-weight pipe, and this thickness depends principally on the length of open hole to be drilled before setting the next string of casing. L. V. W. C.

957. Standard Practices for Field Testing of Drilling Fluids. C. E. Reistle, Jr., G. E. Cameron and R. C. Buchan. *Oil Weekly*, 7.6.37, **85** (13), 26; *Oil & Gas J.*, 10.6.37, **36** (4), 54.—In the exploration and completion of wells in deep horizons careful and accurate testing of drilling fluids is absolutely necessary.

A tentative standard code for the determination of density, viscosity, sand content, gelation and p^H of drilling fluids is presented, and the various tests are discussed and references included which give more detailed information on the subject.

L. V. W. C.

958. Heaving Shale Drilling Featured by Improved Mud and Mechanic Practices. B. Mills. *Oil Weekly*, 14.6.37, **86** (1), 115.—Improved drilling fluids and more efficient mechanical methods are features of the progress made in drilling heaving shale during the past year.

In the Texas area four distinct types of heaving have been observed. These are: (1) a anhydrous disintegration of soft shales, (2) gas pockets that cause the shale to heave into the hole, (3) a swabbing action that disturbed the shale, and (4) expansion of the gas in the drilling mud resulting in a reduction of the weight which permitted heaving.

A satisfactory mud overcame the first type, whilst the gas pockets were controlled by the use of a heavy drilling fluid. The swabbing action resulted from pulling the drill-pipe in a careless manner, and this action was overcome by pumping out the cuttings and circulating out each joint. The fourth type represents a much more important phase of mud cutting, and the solution is possible only when a mud is used which picks up a minimum quantity of gas in those belts of high pressure.

Chemical studies have been continued and various synthetic and chemically treated muds have been used to advantage. Ordinary brine mud was used successfully in one well in Texas. L. V. W. C.

959. Field Control of Drilling Mud. P. H. Jones. *Oil & Gas J.*, 3.6.37, **36** (3), 114.—The quality of the drilling mud to be used in any drilling project and the testing procedures required for the maintenance of this quality are functions of the conditions encountered. The organizations required will fall into two categories. The first is

the control of mud in individual wells located at a distance from laboratory facilities, and the second concerns the control where a number of wells are being drilled in the same area sufficiently close together to permit the establishment of a central field laboratory for making mud tests.

The various tests to be carried out at the individual wells are considered in some detail, together with certain special tests which may be demanded by the conditions encountered.

The mud control of centralized wells is similarly dealt with. L. V. W. C.

960. System for Cooling Mud Solves Problem of High Temperature. D. S. Sneigr. *Oil Weekly*, 24.5.37, **85** (11), 40.—High well temperatures encountered during the drilling of a well in East Texas are being successfully controlled through the use of an original mud cooler. The formation temperature has a destructive effect on the drilling parts. A rotary fluid cooling system has been devised which reduces the mud temperatures. L. V. W. C.

961. World's Deepest Well Flows at 11,630 Feet. C. B. Leyendecker. *Oil Weekly*, 17.5.37, **85** (10), 42.—The Humble Oil and Refining Company's Elender I in the Louisiana Gulf Coast holds several drilling records as well as being the world's deepest producing well.

This well came in at 40 brls. per hour from a depth of 11,620–11,630 ft. It not only shows that wells may be completed successfully at these depths, but also enhances the crude reserve status of the U.S.A. L. V. W. C.

962. Drilling the World's Second Deepest Producing Well. D. S. Sneigr. *Petr. Eng.*, May 1937, **8** (8), 100.—Numerous difficulties were encountered in completing the world's second deepest commercial producer at a depth of 10,437 ft. High gas pressure presented a production problem that was successfully solved by an original flow-line hook-up.

The well was spudded-in in November 1936 and no difficulties were experienced down to 9000 ft. At this depth the gas pressure increased and it became necessary to use a mud weighing 11·5 lb. per gal. On stopping circulation it was found that the mud settled, but since the viscosity was required as high as possible, it was thought safer to leave the mud as it was and if necessary to drill out the section of the hole that had filled.

The flow-line arrangement consists of three lead lines from the Christmas tree to the flow line and a series of six chokes between the flow line and the Christmas tree. 2-in. lines are connected to each side of the Christmas tree, one running to the main flow line and the other is divided by a tee into two lines, which are then connected to the main flow line. Thus the well can be flowed through any one or all three of these outlets. A choke on either side of the Christmas tree reduces the 3700 lb. pressure to 2700 lb. On the tee are two chokes, one on each side, which further reduce the pressure to 800 lb. A further two chokes in the two lines before they enter the main line reduce the pressure to 500 lb.

At the separators the pressure is further reduced. L. V. W. C.

963. Selection of the Final Diameter of Prospecting Bore Holes. V. P. Lyubimov. *Razvedka Nedr.*, 1936, **23**, 23.—The final diameter of the crown is determined by the formula

$$D'_2 = 2{\cdot}25d\frac{(CK)^{\frac{1}{3}}}{\sigma} + 2(e_1 + t + 5)$$

where D'_2 is the final diameter of the diamond shut bit, d the largest diameter of the particle in mm. after disintegration, C the coefficient of loss of the core, K an experimental coefficient which depends on the properties, character and size of the core, σ the density of the core in kg./cm.^{3}, e_1 the space between the core and the inner walls of the bit, and t the thickness of the bit wall in mm. A numerical illustration is given. For. Petr. Techn.

964. Drilling Patents. F. J. Hinderliter. U.S.P. 2,080,715, 18.5.37. Casing head and blow-out preventer.

J. E. Brantly. U.S.P. 2,080,804, 18.5.37. A rotary well-drilling control system operated by the application and partial overcoming of a controllably variable rotation resisting force.

W. L. Church. U.S.P. 2,080,978, 18.5.37. A method of taking cores of the formation comprising lowering a core tube through the drill stem and means for fixing the core barrel to the stem in a predetermined position relative to the drilling apparatus. Withdrawing the core tube with the core and relating the core to the predetermined position of the drill stem to determine the natural inclination of the core strata.

H. D. Wilson. U.S.P. 2,081,190, 25.5.37. Well screen.

A. C. Catland. U.S.P. 2,081,194, 25.5.37. Mechanism for operating a core pump.

A. C. Catland and J. H. Howard. U.S.P. 2,081,195, 25.5.37. Core recovering tool.

A. L. Eastham. U.S.P. 2,081,294, 25.5.37. A side-tracking apparatus comprising an anchor adapted to be located between a whipstock and the opposite wall of a well and able to prevent the turning movement of the whipstock.

C. H. Lane and C. K. Stillwagon. U.S.P. 2,082,010, 1.6.37. Rotary swivel for removable wire-line drills.

L. A. Layne. U.S.P. 2,082,111, 2,082,112 and 2,082,113, 1.6.37. Well packer mechanism.

E. V. Foran, S. S. Parkes and J. G. Bird. U.S.P. 2,082,329, 1.6.37. A method of drilling a well comprising actuating a cutter on a hollow drill stem having an outlet near its lower end. The cutter is adapted to engage the formation and an aerated liquid is forced to the bottom of the well through the drill stem to carry the cuttings to the surface.

L. L. Rector. U.S.P. 2,083,089, 8.6.37. Tubing head.

L. L. Rector. U.S.P. 2,083,090, 8.6.37. Casing head.

L. L. Rector. U.S.P. 2,083,091, 8.6.37. Joint seal.

H. C. White. U.S.P. 2,083,625, 15.6.37. A method of depositing gravel size material around well casings.

E. M. Dares. U.S.P. 2,084,096, 15.6.37. A rotary oil well drilling apparatus in which two concentric strings of drill-pipe are utilized.

J. N. Hummel. U.S.P. 2,084,143, 15.6.37. Process for inspecting the ground drilled by measuring the intensity and direction of the natural electro-chemical currents at different depths by annulling the said natural potentials and currents by sending a current taken from an external source into the ground and measuring the intensity and direction of the current required for the said annulment.

L. V. W. C.

Production.

965. Future of Well Spacing. D. R. Knowlton. *Oil Weekly*, 17.5.37, **85** (10), 51.—The "Law of Capture" is the one largest obstacle that is keeping the industry from attaining a stable and intelligent programme of development. The statutes based on this law are contrary to conservation and economic stability. A programme should be instigated by the industry in order to obtain proper legislation to allow the industry to conserve this natural resource to allocate to each operator his just share of the oil and gas under his property and to make it possible for the operator to recover the largest amount of oil with the minimum of expenditure. L. V. W. C.

966. Production Practices Directed toward Prolonging Flowing Life. B. Mills. *Oil Weekly*, 21.6.37, **86** (2), 17.—The prolongation of the economic life of oilfields of every type has been brought about by refinements in production practices. Among these practices are: pressure maintenance, control of oil/gas ratios, choking practices, improvements in gas-lift operations, paraffin control, acidization and more efficient application of the pumps. Extra efforts have been made in the marginal fields that are affected by low prices and conservation of the formation energy has been the chief objective in the flush flowing fields.

The various practices are dealt with in some detail. L. V. W. C.

967. Increasing Flow of Small Producing Gas Wells. P. W. Meals. *Oil & Gas J.*, 20.5.37, **36** (1), 81.—Recommendations are made that will enable an increase in the gas produced from small producers. Among these are that more care be taken in drilling, casing or cementing new wells to prevent water and mud from penetrating the producing formation.

The use of a light shot of solidified nitroglycerin or dynamite often gives good results, and solvents may be used to good effect. One hundred lb. of sulphuric acid dumped into the sand in a bailer and about 600 lb. of caustic soda dissolved in 60 gals. of water poured in with the acid creates plenty of heat, as well as having a scrubbing effect on the face of the sand, and this has resulted in an increase of gas. An addition of aluminium slugs or pellets to the caustic soda has given the largest increase at the lowest cost. A temperature of 250° F. has been created by this, and the action of the caustic soda on the aluminium has a scrubbing effect.

Injecting or storing gas in the sand appears to open up clogged sand pores and has been beneficial in increasing the gas output. L. V. W. C.

968. Well Shooting with Special Reference to Secondary Recovery Operations. H. M. Ryder. *Oil Weekly*, 10.5.37, **85** (9), 18.—The necessity for shooting has been recognized for many years and in many parts of the world this practice has become almost universal. Guesswork in the selection of size and placement of shells has been generally due to the difficulty of observing the exact effects of a shot.

Various views are propounded as to the physical effect of the shot on the sand. From evidence obtained there appears to be some actual enlargement of the mean diameter of the hole itself opposite the shot. Many of the fractures formed are, at least in part, vertical.

The pressure gradient is the primary source of production, and wells are shot for increasing this gradient. A formula for a water-flooding five-spot pattern is given and the use of this pattern is indicated by means of a number of curves.

L. V. W. C.

969. Unusual Operating Conditions Found in Capitan Field of California. T. P. Sanders. *Oil & Gas J.*, 27.5.37, **36** (2), 28.—The complicated nature of the Sespe formation in the Capitan field necessitates unusual well completion practice. The gas zone and the water above the oil are cased off by 8¾-in. casing, whilst the two oil zones are both produced in the same well, where they are both productive, and the intermediate water between the two must be cased off with the liner.

After the hole has been cored through the two producing zones a liner is made up so that the sections apposite the oil-bearing zones will be perforated and the solid section will cover the water-bearing zone. This solid section is then cemented using canvas baskets, the upper one inverted. The perforations are then thoroughly washed out.

Under normal drilling one engine drives the rotary table and one the pumps, whilst these are compounded to operate the draw-works. A sand reel is built into the unit just behind the hoist drum of the draw-works and is used to run the wire line core barrel. L. V. W. C.

970. Pressure Maintenance Operations in the South Burbank Pool. J. C. Albright. *Petr. Eng.*, May 1937, **8** (8), 58.—An important feature of the programme of the South Burbank Pool is the maintenance of reservoir pressure after the pool had been partly developed.

As this pool was the first in Oklahoma to begin a programme of pressure maintenance, surveys were begun at the outset to determine the areas of greatest gas/oil production to enable the gas-cap to be outlined. An irregularity of gas-cap was found.

Some of the input wells were converted from original producers, whilst others were drilled expressly for the purpose. All gas produced and handled in the field is metered at various points, thus allowing an accurate accounting of every cub. ft. of gas produced from the wells and the volume consumed for fuel.

As large a percentage of gas as possible is returned to the sand; high pressures have been held on the producing sand as a consequence and the fall in reservoir pressure has been relatively small. L. V. W. C.

971. Pressure Maintenance and Unitization—South Burbank Pool. J. S. Salnikov and M. L. Haider. *Oil Weekly*, 7.6.37, **85** (13), 34.—The South Burbank pool, which consists of approximately 4000 productive acres, has had 2720 acres unitized. The reasons for unitization were twofold. First, to carry out a pressure maintenance programme by returning gas to the formation, and second, to effect economies in the development and exploitation of the properties. Approximately 16,000,000 cub. ft. of gas per day are returned to the reservoir. This is equivalent to 1640 cub. ft. per barrel of oil produced. Data collected indicate a reduction in the rate of reservoir pressure decline due to the gas injection, and preliminary work shows that the gas/oil ratio can be controlled by the use of packers. These are discussed.

L. V. W. C.

972. Methods of Controlling Pressures. B. Mills. *Oil Weekly*, 14.6.37, **86** (1), 85.—The abnormal pressures encountered in the Gulf Coast demand the use of special muds and heavy surface equipment. Constant attention to the drilling fluid is demanded where gas complicates pressure control. The mud will reflect the presence of high pressure gas or salt water, and the chief method of attack is centred on the drilling fluid.

The experiences of two wells in this area are given, together with the methods used to control them. L. V. W. C.

973. Control Systems for High-Pressure Distillate Wells. M. N. Aitken. *Oil Weekly*, 10.5.37, **85** (9), 30.—A considerable number of distillate wells have been brought into production during the last few years, and recent developments have enabled a considerable quantity of the gas produced to be used.

The tubing pressure in some of the wells in the Gulf Coast is in the neighbourhood of 3200 lb. per sq. in., with an open flow capacity of more than 100 million cub. ft. per day.

The equipment of high-pressure well-control systems on wells that had not previously been so equipped resulted in an increase in the production of oil. The well-control system could not have produced this result, but it can be partly explained by the evaporation and condensation to a liquid stage which has in some way broken up the equilibrium that existed between the gas and the light ends of the oil as well as the gas liquefied due to the pressure. Better separation is obtained and a very stable oil results. L. V. W. C.

974. Vibration Problems in Oil Wells. G. C. Slonneger. *Oil Weekly*, 7.6.37, **85** (13), 52.—A simplified method of calculating vibration frequencies as applied to sucker rods and cable tools is discussed and reference charts for these frequencies are given. The effects of vibration on oil-well pumping are dealt with and it is shown that the vibration of the rods has a definite effect on the contour of the dynamometer card. This is shown by the development of a series of theoretical cards from the standpoint of vibration and well loads which have characteristic contours. Numerous dynamometer cards taken from a number of wells and covering a variety of well conditions are given to confirm the theoretical consideration. L. V. W. C.

975. Present and Future of Pumping in the East Texas Field. J. L. Nye and E. B. Miller, jr. *Oil Weekly*, 31.5.37, **85** (12), 24; *Oil & Gas J.*, 27.5.37, **36** (2), 41.—The present tendency in the East Texas field is for wells along the west side to operate

with individual and multiple well hook-ups of from 35 to 40 H.P.-rating and along the east side with multiple hook-ups.

Long stroke pumping will probably have an important place in future production methods, and new types of long stroke units are being built that permit greater rod travel, thus reducing the number of reversals, and increasing the output per inch of polished rod travel.

It is difficult to estimate the amount of trouble arising from abrasive action of sand, but it is almost certain to be considerable. Paraffin will continue to be a problem in producing oil, especially where flow rates and pumping speeds are slow. Precautions should be taken to prevent the separation of paraffin and methods used to retard its accumulation. L. V. W. C.

976. Advancement in Gas-lift Operations. S. F. Shaw. *Oil Weekly*, 21.6.37, 86 (2), 19.—Advancement in gas-lift operations has been made along several different lines. Among these are: (1) advanced knowledge in the use of gas-lift; (2) better methods, including the use of proper sizes of casing and tubing; (3) improved machinery resulting in greater lifting capacity and reduced lifting costs, and (4) better co-ordination in the application of the improved machinery to the lifting operation.

The quantities of gas required for lifting oil under different conditions of depth through different sizes of pipe and for lifting different kinds of oil have been studied. This has led to a study of the factors that influence the flow of oil into the well when lifting it at different rates of production.

Chokes have been used in casing and tubing and a determination of the least rate at which to flow the well has contributed to a better understanding of the effects of choking the wells to different rates of flow.

Many forms of intermittent flow have been tried and various designs of intermittent controllers have been used.

Combination methods have been in use for a considerable time, and the best result has been obtained with the submerged electrical centrifugal pump combined with gas-lift. L. V. W. C.

977. Use of Gas-Lift and Flow Valves in the East Texas Field. R. A. Ancoin. *Oil Weekly*, 31.5.37, 85 (12), 44; *Oil & Gas J.*, 3.6.37, 36 (3), 74.—Gas-lift wells of the East Texas field may be divided into four distinct classes: (1) high-fluid-level wells, capable of producing more than the prorated allowances, (2) low-fluid-level wells capable of producing slightly more than 20 brls. per day, (3) high-fluid-level wells with high water percentages, and (4) wells capable of producing less than 20 brls. per day.

The first class need only to be agitated to start flow, and valve spacing to obtain low ratios on input gas or high velocities requires little thought.

The second class are most difficult, and it is often necessary to release the casing pressures at the end of producing periods to allow oil to fill into the tubing and annular space. Chamber intermitters can handle satisfactorily this type of well.

The third group is similar to the first, whilst the fourth class is the most difficult. Chamber intermitters seem to be the answer to efficient operations for these wells. L. V. W. C.

978. Cleaning Oil Sands with Hot Air. F. R. Cozzens. *Petr. Eng.*, June 1937, 8 (9), 55.—Good results are being obtained in the shallow sand fields of Southern Ohio by the practice of clearing oil sands with hot air.

When the well becomes a stripper, and before the natural rock pressure is entirely gone, a packer is run-in on the necessary length of insulated tubing. The upper end of the tubing is connected to a gas-engine-driven compressor and compressed air heated in the cylinder to a temperature of 300° F. is injected down the well. Injection is continued until the pressure in the casing reaches from 600 to 1000 lb. per sq. in.

The pressure is then released, and the packer removed, and after the well has been permitted to clean itself, the packer is again run and the hot air again forced into the well. It may be necessary to do this two or three times. A marked improvement in natural rock pressure may be observed. Greater volume of production, better grade of oil and prolonged life of the well are some of the beneficial results of hot-air sand cleaning. L. V. W. C.

979. Interesting Methods of Completing Wells. Anon. *Oil Weekly*, 21.6.37, **86** (2), 44.—The methods of discovering, locating sands and completing wells in the Corpus Christi area of South Texas are of interest inasmuch as the deceptive sands found in this area made it necessary for new and modern methods to be used for the production of oil.

The casing setting practices are decided after the conditions existing have been considered. In some instances the casing is set on top of the sand and the well produces from the annular space represented by the difference in the outside diameter of the screen and the diameter of the hole. Full-hole cementing is also carried out, whilst in a number of wells the casing is set through the oil sand and gun perforating then carried out.

Various other methods are in use and these are given in some detail.

L. V. W. C.

980. Care and Repair of Deep Well Pumps. D. E. Schnobrich. *Oil Weekly*, 21.6.37, **86** (2), 23.—The recent development of several new maintenance and operating processes and methods has permitted appreciable progress to be made in obtaining continuous operation of deep well pumps with a minimum of trouble and expense.

New servicing processes have been devised and the success of the efficiency servicing processes is in the procedure affecting the liners.

The haphazard methods of the past have been replaced by scientific methods and the importance of efficient operation is known to be in direct proportion to the amount of expenditure as well as to the amount of production obtained.

The arrangement of the liners so that those bearing the least amount of wear are kept constantly on the stroking area has been a distinct advantage. Similarly the reboring processes alone have been directly responsible for reducing liner purchase costs fully 50 per cent.

L. V. W. C.

981. Extension Well in El Segundo Field Completed by Unusual Practice. T. P. Sanders. *Oil & Gas J.*, 6.5.37, **35** (51), 47.—It has been standard practice to core through all portions of the section in the Los Angeles basin wells, but where tests are drilled close to producing wells coring is resorted to less frequently.

In the largest producer in the El Segundo field coring was started at 7200 ft. and was continued to 7256 ft., showing only schist. An electrical log was then made and the results indicated that the productive zone was 200 ft. higher up than in the wells in the field. A wall sampler was therefore run to check up the electrical log and samples obtained verified the indication of the electrical log.

An interesting piece of equipment used at this well was a rubber kelly bushing. This resulted in less noise at the rotary table and hardwood insets reduced the wear on the kelly joint. Casing pressures of 1040 lb. and tubing pressures of 890 lb. were recorded.

L. V. W. C.

982. Sucker Rod Life Prolonged by Elimination of Abuses. B. Mills. *Oil Weekly*, 24.5.37, **85** (11), 16.—Failure of sucker rods is brought about in many instances by abuse, but these failures may be overcome by following certain practices. Abuse occurs during transportation, storage, running and pulling and in pumping operations. More efficient service can be provided by the use of trained crews, proper tools, well studies and strict rules for all handling.

L. V. W. C.

983. Care and Maintenance of Wire Ropes. W. Voigtlander. *Oil Weekly*, 17.5.37, **85** (10), 19.—The various abuses to which wire ropes are commonly subjected are considered. The elimination of these abuses of installation and of operation and the proper maintenance of both rope and equipment will increase the proportion of failures eliminated.

L. V. W. C.

984. Progress Made in Extinguishing Burning Texas Well. P. R. Clegg. *Petr. Eng.*, May 1937, **8** (8), 33.—A well in the Agua Dulce field, Texas, has been burning for almost six months, and control methods are at last beginning to show results. This well caught fire on November 19, 1936, and since that time every known method

has been employed to obtain control and extinguish the flames. Mud and water are still being produced while the well burns. Large quantities of mud and water have been forced to the bottom of the hole through a relief well at a pressure of 200 lb.

A directed hole was started with the intention of hitting the bottom of the burning well, but difficulties were encountered and the well was bottomed at the point it struck. The estimated distance from the burning well to the relief well was within a 90-ft. radius.

A series of pumps provide a continuous flow of heavy mud and water at a pressure of 2000 lb. and a capacity of 1000 brl. per hour in the hope of mudding up the area completely at the base of the wild well and so shutting off the flow of gas.

L. V. W. C.

985. Burning Well Now is Normal Producer. K. C. Sclater. *Petr. Eng.*, June 1937, **8** (9), 33.—The Continental Oil Company's Well in Lea County, New Mexico, which was recently completed and brought in as a normal well, caught fire, but after burning for ten days was placed under control with the casing and casinghead intact. Three main factors contributed to successfully bringing this well under control. First, the expert judgment and care exercised in handling and placing the explosives for snuffing out the fire; second, the efficient method employed in setting the casings and tying them at the surface, and third, the innovation of shutting off the well several hundred feet below the surface by means of a removable casing-plug. This last factor enabled the casing and casinghead to be inspected and replacements made with comparative safety.

L. V. W. C.

986. Wild Well Brought Under Control After Two Failures. P. Reed. *Oil & Gas J.*, 29.4.37, **35** (50), 64.—A wildcat well which blew-in in the Marlow area, Oklahoma, has been controlled at the third attempt by the use of weighted mud. The weight of this mud was 16·2 lb. per gal., viscosity 60 centipoises and a p^H of 8·9. The mud was pumped in at the rate of 250 brls. per hour, and the job occupied 4 hours. Fibrous material was added to the mud, and this effectively bridged off cracks, crevices and fissures.

L. V. W. C.

987. Production Patents. G. A. Humason. U.S.P. 2,080,610, 18.5.37. Combination blow-out preventer, casinghead construction.

W. F. McMahon. U.S.P. 2,080,622, 18.5.37. Apparatus for entraining oil and gas from oil wells.

W. F. McMahon. U.S.P. 2,080,623, 2,080,624, 18.5.37. Oil well pumps.

J. D. Nixon and C. L. Ferrell. U.S.P. 2,080,736, 18.5.37. Oil well packer with means to release the cup of the packer to permit it to engage a casing wall at the desired point.

M. B. Pitzer. U.S.P. 2,080,875, 18.5.37. A method of increasing the well flow by inserting a treatment fluid and then breaking up the wall of the well adjacent to the fluid by firing solid substances into it.

R. R. Bloss and R. C. Pfeil. U.S.P. 2,081,140 and 2,081,141, 25.5.37. An attachment for the crankshaft of well pumping mechanism for a counterbalancing device. Means carried by the crankshaft for moving the weight centre toward or away from the crank arm hub.

C. J. Coberly. U.S.P. 2,081,220, 2,081,221, 2,081,222, 2,081,223, 2,081,224 and 2,081,225, 25.5.37. Deep well fluid operated pump and parts.

J. H. Howard. U.S.P. 2,082,107, 1.6.37. An assembly for sealing well heads.

H. L. Patton. U.S.P. 2,082,216, 1.6.37. Fire-extinguishing apparatus and method of controlling a well from which fluid is flowing under pressure.

E. C. Weisgerber. U.S.P. 2,082,863, 8.6.37. Oil and gas separator.

R. L. Chenault. U.S.P. 2,083,687, 15.6.37. Deep well pump.

E. D. Keeler. U.S.P. 2,083,714, 15.6.37. A fluid pressure bailer.

C. H. M. Roberts. U.S.P. 2,083,799, 15.6.37. Method of and apparatus for lectrically treating emulsions.

W. Woelflin. U.S.P. 2,083,800, 15.6.37. Pipe-line treating system for emulsions.

H. C. Eddy. U.S.P. 2,083,801, 15.6.37. Method and apparatus for dehydrating petroleum.

W. Woelflin. U.S.P. 2,083,802, 15.6.37. A method of electrically treating emulsions. L. V. W. C.

Gas.

988. Gas Conservation. F. P. Peterson. *Oil Weekly*, 21.6.37, **86** (2), 34.—Important strides are being made along the South Texas Gulf Coast in the conservation of gas by the establishment of markets for products previously blown to waste. Improved gasoline plants are being put into operation in the South Texas area.

An entirely new system has been devised in the Saxtet field in which the gas is being taken from the wells under various pressures, and by the installation of proper control equipment the wells are so controlled as to produce efficiently and at the same time enable operation of the plant at a steady rate.

The natural gasoline plants handle the residue gas separated from the oil, the gasoline goes to storage, while the dry tail gas is available for several uses. A carbon-black plant will be erected to absorb that portion of tail gas not now being used. The gasoline stripped from the gas is blended again with the crude. L. V. W. C.

989. Electrical Preparation of Hydrogen from Petroleum Gas. G. M. Egorova and A. M. Doladugin. *Natural Gases U.S.S.R.*, 1932, **4**, 53.—A Grozny natural gas containing 55·1% CO_2, 11·3% C_2H_4, 18·6% C_3H_6, 11·5% C_4H_{10} and 2·3% C_5H_{12} + was passed through an electric arc operated with A.C. current at 400–500 volts and 7–12 amps. The yield of hydrogen was 74% without recycling and 88% with recycling. For. Petr. Techn.

990. Utilization of Cracked Gas for Town Gas Carburation. R. Kada. *J. Fuel Soc. Japan*, 1937, **16** (175), 41.—To raise the heating value and increase the production of town gas the Yokohama Municipal Gas Works have contracted to purchase cracked gas from a local refinery. This gas has an average heating value of 13,000–14,000 cal./cu. m. and is to be mixed with retort-generator gas to give an average value of 3800–4000 cal. Direct mixing has involved certain difficulties, and the most convenient method has proved to be the installation of a supplementary small gas producer, the gas from which is used to dilute the cracked gas before mixing with the main volume of gas. The finished town gas contains 11·7% cracked gas, 60·0% retort gas and 28·3% producer gas. G. R. N.

991. Patents on Gas. W. W. Triggs. E.P. 466,483, 31.5.37. Conversion of natural gas into liquid hydrocarbons.

H. Koppers' Ind. Maat., N.V. E.P. 466,737, 3.6.37. Production of mixture of CO and H_2 suitable for the synthesis of hydrocarbons by conversion of coke with steam in an intermittently operated water-gas producer. W. S. E. C.

Crude Petroleum.

992. Patents on Crude Petroleum. M. de Groote and B. Keiser. U.S.P. 2,079,762–2,079,764, 11.5.37. Breaking petroleum emulsions by means of a demulsifying agent, *e.g.* product obtained by blowing castor oil.

M. de Groote and B. Keiser. U.S.P. 2,081,003, 18.5.37. Breaking petroleum emulsions by means of an addition product of a non-carboxy aldehyde obtained by decomposing a ricinoleic compound.

M. de Groote and A. F. Wirtel. U.S.P. 2,081,004–2,081,005, 18.5.37. Process as described above, the demulsifying agent being the diethyl*cyclo*hexylamine salt of tri*iso*propylated naphthalene sulphonic acid admixed with a suitable solvent.

W. S. E. C.

Cracking.

993. Recent Developments in the TVP Process. G. V. Davies. *Petr. Times*, 12.6.37, **37** (961), 806.—The significant feature of the TVP process lies in the heating of the oil vapours, produced at temperatures below the cracking temperature, by direct contact with hot inert carrier-gas, usually termed cycle gas. The recent advances in the production of heat-resisting alloys have increased the range of application of the process while increasing its reliability and decreasing operating costs. Light distillates so produced are characterized by their high octane number and excellent gum stability. The process has recently been successfully applied to shale and torbanite oils.

H. G.

994. Cracking Methane in the Glow Discharge. D. K. Koller. *Khem. Tverd. Topliva*, 1936, **7**, 808.—The yield of acetylene from methane increases with duration of exposure of methane in the discharge zone, reaching a maximum determined by the conditions of the process, then falling off gradually. The best exposure time is 0·06–0·1 second. The percentage of cracked methane is practically proportional to the duration of its exposure in the discharge zone, if it is short. The process is characterized by a consumption of energy (q) in w.-hrs. per litre of acetylene formed, the best value for which is 1·6–2·4 w.-hrs. per litre at a pressure of 110–120 mm. Hg, and while keeping methane in the discharge zone for about 0·2 second or less. In the electric cracking with recycling, a mixture of gases containing 80–90% methane may yield a gas containing 16·5% acetylene with an energy consumption of 13–14 kwh. per cu. metre of acetylene, if the current density were increased each time at an optimal (q). The effect of dilution of methane by hydrogen on the acetylene yield may be expressed by a rectilinear relationship. The character of the influence of pressure on the reaction depends on the duration of exposing the gas to the discharge, current strength, q, and the methane content in the initial gas, and cannot be generalized. 5 references.

For. Petr. Techn.

995. Patents on Cracking. G. W. Johnson. E.P. 466,609, 1.6.37. Catalyst for thermal conversion processes consisting of a pretreated bleaching earth containing Floridin, fuller's earth, Terrana, etc.

E. J. Houdry. U.S.P. 2,078,946, 4.5.37. Conversion of hydrocarbon oil into benzene, gasoline, kerosene, diesel fuel, etc., in one operation without internal recycling.

E. J. Houdry. U.S.P. 2,078,950, 4.5.37. Operation of catalytic converters.

E. J. Houdry. U.S.P. 2,078,951, 4.5.37. Method of acceleration of the regeneration of contact masses used in the catalytic conversion of hydrocarbons.

D. L. Thomas. U.S.P. 2,079,191, 4.5.37. W. E. Lobo. U.S.P. 2,079,219, 4.5.37. L. de Flores. U.S.P. 2,080,221, 11.5.37. Improved oil furnace.

R. M. Parsons. U.S.P. 2,079,333, 4.5.37. L. A. Mekler. U.S.P. 2,080,731, 18.5.37. Improved flash-chamber for oil-cracking plant.

E. A. Ocon. U.S.P. 2,079,359, 4.5.37. Cracking in which the cracked vapours of an oil-stream mixture are desulphurized by means of catalysts prior to the final fractionation and condensation of low-boiling products.

C. H. Angell. U.S.P. 2,081,347–2,081,348, 25.5.37. Topping, cracking, coking and reforming in a co-operative manner to produce high yields of motor fuel of good anti-knock value with minor yields of coke and gas.

J. S. Wallis and J. C. Mahoney. U.S.P. 2,081,440, 25.5.37. Two-stage distillation unit for cracking plants.

C. M. Ridgeway. U.S.P. 2,081,601, 25.5.37. Method and apparatus for automatically controlling the withdrawal of a side stream from a fractionating tower.

D. R. Johnson. U.S.P. 2,081,628, 25.5.37. Improved pipe still.

W. S. E. C.

Hydrogenation.

996. High-Pressure Hydrogenation of Low-Temperature Tar. S. Ando. *J. Fuel Soc. Japan*, 1937, **16** (174), 21.—An account is given of an experimental study of the variables in the hydrogenation of low-temperature tar, its distillate, the neutral oil and phenolic oil fractions using an electrically heated 5-litre horizontal rotating autoclave. It was concluded the higher the reaction temperature and the longer the reaction time the higher was the content of aromatic and naphthenic hydrocarbons, and that the formation of low-boiling hydrocarbons was obtained the most easily from neutral oils. The lower the boiling range of the sample treated the more hydrogen was consumed and the more gasoline was produced under the same operating conditions. The gasoline from phenolic oil had a greater content of aromatics and naphthenes than that from neutral oil. Tabulated data are given. G. R. N.

997. Production of Gasoline and Lubricating Oils by Catalytic Hydrogenation under Pressure. G. Fauser. *Chimica e Industria*, 1937, **19**, 113–122.—The importance of the hydrogenation process, particularly to countries with no natural petroleum resources, is emphasized. The development of the technique of hydrogenation (of bituminous coals, tars, shale oils, petroleum residues, etc.) is surveyed and some indication is given of the capacities of the plants now in operation in Germany, the United States and England. In Italy the Government have formed a national Hydrogenation Company, and two installations are under construction at Bari and Livorno with a capacity of 120,000 tons of gasoline per annum in addition to lubricating oils, kerosine and liquefied gases.

In this connection Italy has secured a concession for Albanian petroleum which, together with tars obtained from native lignite, will provide the raw materials for the process. C. C.

998. Patents on Hydrogenation. G. W. Johnson. E.P. 466,524, 31.5.37. Manufacture of heavy oil free from or poor in asphalt by extraction or mild destructive hydrogenation of finely divided brown coal using an iron oxide and an alkali as catalyst. The extraction solvent is a light aliphatic hydrocarbon containing 4–9 carbon atoms in the molecule. The oily layer is separated from the asphalt layer, the extraction solvent removed from the oily layer and the latter is divided by distillation into the desired high-boiling fraction and fractions of lower b. pt., which are admixed with the asphaltic layer and used as fresh initial material.

W. Thomas and E. L. Davies. E.P. 466,708, 1.6.37. Apparatus for the hydrogenation of carbonaceous substances using an electrolytic cell.

International Hydrogenation Patents Co., Ltd. E.P. 467,147, 11.6.37. Hydrogenation of unsaturated hydrocarbons, *e.g.* di*iso*butylene, to produce *iso*-octane using a molybdenum sulphide catalyst. W. S. E. C.

Polymerization.

999. Polymerization and What it May Mean to the Natural Gasoline Industry. G. G. Brown and D. L. Katz. *Oil & Gas J.*, 27.5.37, **36** (2), 30.—The general outlines of present type polymerization processes are discussed and the possible effect of the increased demand for butane on the method of operation and economic position of natural gasoline plants indicated.

Present polymerization processes include:

(1) Once-through cracking and polymerization of butane rich fractions, followed by fractionation of the desired product and recycling of the gas and light fractions through the plant with fresh feed. Yields of 55–63% of polymer gasoline of an octane blending value 80–110 have been obtained by the method.

(2) Cracking of butane and subsequent polymerization of the cracked material, the insufficiently converted material being recycled through the plant. A yield from natural gas—containing 70% CH_4, 12·7% C_2H_6, 10·3% C_3H_8 and 6·4% of C_4H_{10} and higher—of 21 gals. of gasoline of 105–125 octane blending value per 1000 cu. ft. is reported. (Equivalent to 26% liquid volume or 47% based on the C_2H_6, C_3H_8 and C_4H_{10} components.)

(3) Catalytic polymerization at 450° F. and 200 lb. per sq. in. of cracked gasoline stabilizer overheads, any saturated hydrocarbons being cracked by the thermal or catalytic process. A yield of liquid polymer amounting to 90% of the C_3H_6 or C_4H_8 components is obtainable.

Owing to the ease of obtaining pure C_4H_{10}, C_3H_8 and C_3H_6 for experimental study, these hydrocarbons form the likeliest intake material for future polymer plants. The catalytic processes which operate at lower temperatures and pressures may ultimately prove more economical and satisfactory than the thermal processes.

The high octane blending value of polymer gasoline is likely to lead to refiners removing as much as possible C_4H_8 and C_4H_{10} from the gasoline, thereby giving a product of lower vapour pressure and creating a demand for more natural gasoline for blending with this and polymer gasoline. On the other hand, assuming a constant fuel demand, the increasing amount of polymer gasoline may result in a lower demand for ordinary and natural gasoline. Based on the natural gasoline production of 1936, it is estimated that a potential source of 58 million gallons of high-octane fuel is available.

In order to meet the increased demand for butane, absorption plants are being modified by increasing the oil rate, increasing the pressure or decreasing the temperature. The installation of expensive polymer plants at natural gasoline plants may be restricted by the more or less temporary nature of absorption plants, but it is pointed out that a blend of both products would provide a premium fuel of which the characteristics could be adjusted for all conditions. C. L. G.

1000. Increasing the Resources of Raw Material Available for Polymerization. S. M. Gabrielyan and S. A. Isaeva. *Cavoz. heft.*, 1937, **7**, 41.—If we accept 12–13% for the mean content of propylene–butylene in the original cracked gas, then on pyrolyzing we may increase the content of the above hydrocarbons to 16%, while the content of C_2H_4 may be increased fifteen fold. The yields of olefins are slightly higher when pyrolyzing in the presence of catalysts, although the latter are rapidly covered up with carbon, thus losing their activity. In the pyrolysis of the cracked gas the yield of C_3–C_4 gases decreases with duration of contacting at the experimental temperatures (550°, 660°, 700° and 750° C.). It is irrational to pyrolyze wet gas, and it is recommended to pyrolyze the dry gas after extraction of C_3–C_4 hydrocarbons. The highest propylene–butylene yields were obtained when pyrolyzing propane–butane fractions at 650° C., contact time 1·5–3·0 seconds. Of the catalysts examined Cr_2O_3 gave the best results. For. Petr. Techn.

1001. Patents on Polymerization. Standard Oil Development Co. E.P. 466,066, 21.5.37. Production of high anti-knock blending stock by polymerizing a mixture of *iso*butylene and *n*-butylene at 150–200° C. and 50–100 lb. pressure per sq. inch.

F. E. Frey. U.S.P. 2,079,935, 11.5.37. Catalytic polymerization of gaseous olefins to produce gasoline. W. S. E. C.

Refining and Refinery Plant.

1002. Recent and Future Developments in Petroleum Refining. R. Simard. *J.S.C.I.*, 1937, **56**, 520–526.—This article is an outline of the present-day position in the production of synthetic hydrocarbons by catalysis and polymerization. The complexity of the subject is illustrated by a table, taken from the literature, of the thermal reactions of propylene.

The chief polymerization processes are described. The unitary process of the Polymerization Process Corporation utilizes refinery gases and is essentially one of

high temperature and pressure, *e.g.* 1000–3000 lb. per sq. in. and 1000° F. The process yields 6–8 gallons of gasoline per 1000 cu. ft. of gas, with an octane number of 82 and an octane blending value of up to 112. The Multi-coil Process of the Pure Oil Co. also uses refinery gases at high temperatures, but uses both high and low pressures. The process yields two types of gasoline, one with an octane number of 73 and a blending value of up to 112, and the other with an octane number of 94 with a blending value of up to 102. The yield from this process is 4–10 gallons per 1000 cu. ft. of gas.

Of the catalytic polymerization processes, that of the Universal Oil Co. is the most extensively used. It utilizes cracked refinery gases or the products of the dehydrogenation of propane–butane gases into olefinic compounds, operates at 200 lb. pressure and at a temperature of 450° F. and uses a solid phosphoric acid as catalyst. This catalyst is not poisoned by sulphur, and when spent can be regenerated by air burning in the tower. The process yields about 18 gallons per 1000 cu. ft. of gas feed. The gasoline has an octane number of 83 with a blending value of 132.

The great importance of *iso*propyl ether and the method of its manufacture are mentioned. The production of *iso*-octane is outlined and the chemical synthesis structurally tabulated. The problem of full utilization of these synthetic fuels is explained. Their boiling ranges render the blending of ordinary gasoline essential, and hence maintain the use of tetraethyl lead. Numerous side reactions of the commercial processes offer great possibilities. Among them are: isomerization, such as the conversion of *n*-octane to *iso*-octane, cyclization or the conversion of hexylene to *cyclo*hexane, and alkylation, such as *iso*-octane from *iso*butane and butylene. A long list of organic compounds which may be synthesized is given.

The article concludes with a review of the octane number position, including a list of octane numbers, taken from the literature, of pure hydrocarbons. The author sounds a warning to the tetraethyl lead and motor benzole producers, and points out that twenty-five plants for polymerization of gases are now operating or under construction, involving an expenditure of $20,000,000. T. C. G. T.

1003. Use of Filter-Aids in Improving Quality of Refined Products. F. L. Horine. *Oil & Gas J.*, 27.5.37, **36** (2), 62.—Siliceous filter-aids are used: (*a*) to clean cracked residuum, (*b*) in wax filtration, (*c*) as a catalyst carrier, (*d*) in emulsion breaking and dehydration, and (*e*) in conjunction with bleaching earths.

(*a*) Carbonaceous matter, ash, lime salts, etc., are removed from cracked residues by coating the metal screens with 50–100 lb. of filter-aid suspended in cycle oil and then passing the residue through the coated screen. The cost in a typical unit is given as 22 cents per barrel.

(*b*) The finely divided or soft wax from distillates or residual stocks is removed by dilution, chilling and mixing in an insulated tank with filter-aid before passing to the filters. The filter-aid is recovered by washing with cold solvent, discharged to an agitated vat containing the solvent, and the slurry warmed to dissolve the wax, and filtered. It is then washed with warm solvent and dried with flue or other inert gases, care being taken to prevent it from becoming wet. Filter-aid may also be used to lower the cloud-point of asphalt base oils.

(*c*) The porous structure, low specific gravity and chemical inertness render filter-aid a suitable catalyst carrier in the manufacture of sulphuric acid, the hydrogenation of fats and oils, and in polymerization processes. The filter-aid is either coated or mixed with the catalyst and dispersed through the liquid and later removed by filtration, or a vapour or liquid may be passed through a stationary bed of the mass.

(*d*) Water, slimy suspended matter and salt are removed from crude oils or refinery emulsions by passing through a precoated filter. The water particles are separated from the oil in passing through the fine capillaries in the filter, and form drops on the other side of the filter. Consumption of filter-aid varies from 0·01 to 0·1 lb. per brl. of dry oil recovered.

(*e*) Mixed with bleaching earth, filter-aid is used in the refining of light and heavy oils, as it renders the filter cake more porous, speeding up the rate of filtration. With excessive amounts of pepper sludge it is advisable to precoat the filter with filter-aid.

In addition to the above uses, filter-aid has the valuable property of removing small traces of moisture from oils, thereby increasing, *e.g.* the dielectric strength of the oil. C. L. G.

1004. Refining Cracked Distillates. A. N. Bassov and A. E. Dembo. *Neft Khoz.*, 1936, **5**, 40.—The best methods for refining cracked distillates are: (1) treatment in the vapour phase with clay followed by addition of an inhibitor (α-naphthol) (for low sulphur content) and (2) hydrogenation (high sulphur content). For. Petr. Techn.

1005. American Processes for the Regeneration of Oils. E. Graefe. *Petr. Zeit.*, 26.5.37, **33** (21), 1.—Various types of apparatus and processes used in the regeneration of used oils are described in detail. Diagrams are given of the apparatus and the main features of each process emphasized. W. S. E. C.

1006. Design and Analysis of Fractionating Columns for Complex Mixtures. P. Docksey. *J.I.P.T.*, 1937, **23**, 316–349.—Methods are evolved to make the plate-to-plate calculations in both the rectifying and stripping sections of a fractionating tower under continuous operation, and are applied to the design of this tower according to the duty it must perform. G. R. N.

1007. A Design for an Experimental Solvent Extraction Tower Unit. H. G. Smith. *Nat. Petr. News*, 23.6.37, **29** (25), 46.—The essential features of the unit are three glass tubes 5 ft. long $1\frac{1}{8}$ in. interior diameter jointed by means of rigid joints of special design. The sections are separately jacketed in a manner permitting jacket temperatures to be controlled independently. The charging stock and solvents are handled by small pumps. H. G.

1008. Removal of H_2S by the Phenolate Process. A. R. Powell. *Nat. Petr. News*, 16.6.37, **29** (24), 50.—In the plant described H_2S is removed from refinery-still gas by washing with a cold aqueous solution of sodium phenolate containing 12% wt. NaOH and 35% wt. phenol. It is claimed that 98% wt. of the available H_2S is recovered. The H_2S is converted into H_2SO_4 and the process is said to be economically attractive from this point of view. The gas is washed in a bubble-cap tower of conventional design. The sodium phenolate is led in on to the fourth tray down, water being fed to the upper ones to trap free phenol in the scrubbed gas. The foul phenolate is led from the bottom of the tower, through a heat exchanger, against hot recovered solution, and passed down a second bubble tower heated at the bottom by steam coils. H_2S is thus removed by boiling and is led off from the top of the tower. The plant described has a capacity of 16,000,000 cu. ft. of gas per day. The cost of the process is given as $6.9 per ton of S removed as H_2S. H. G.

1009. Refining Montan Wax by Chromic Acid. V. I. Kuznetsov and I. R. Rominskii. *Khim. Tverd. Topliva*, 1936, **7**, 798.—Montan wax, freed of tar, was twice treated with 42% H_2SO_4 and CrO_3 at 105°–107° C., yielding a product with an Ubbelohde melting point of 85·6° C. For. Petr. Techn.

1010. Relation between Refinery Departments and the Laboratory. G. F. Fitzgerald. *Refiner*, 1937, **16** (2), 81.—A general discussion of the lack of co-operation that may and does easily develop between interdependent departments of a refinery. It is suggested that this can only be avoided by the use of a well-integrated system of full time supervision and method of reporting. G. R. N.

1011. Nickel-Bearing Alloys for Refinery Service. B. B. Morton. *Refiner*, 1937, **16** (3), 101.—In solvent extraction and dewaxing at low temperatures (— 50° F. to — 75° F.) necessary equipment can be constructed of 2·25–2·75% nickel-bearing steels, because these alloys permit ease of fabrication, satisfactory weldability and retain in both plate and weld at — 50° F. a high proportion of the impact value at room temperature. The 2·5–3·5% nickel cast steels are finding application in valve bodies and parts, pump parts, fittings, and as exchanger shells and heads. Investigation has shown also that the effect of sub-zero temperatures on Monel metal improves its physical properties. In refining by means of sulphuric acid it has been proved that sludge lines and valves of Ni alloys (Causul metal) give long service. A reciprocating pump to handle hot acid sludge should give satisfactory service when

containing cast S Monel liners, Monel rings, cast or wrought Monel pistons, K Monel rods and Hastelloy D/Illium valves. In the fields of distillation and cracking the corrosive effects of hydrogen sulphide and hydrogen chloride on heater tubes, hot oil lines, exchanger tubes, etc., can be largely minimized by the use of 18 : 8 chrome–nickel alloys. G. R. N.

1012. Intermediate Steels for Refinery Service. H. D. Newell. *Refiner*, 1937, **16** (3), 108.—In the past three years several low-alloy-content steels having properties suitable for refinery application have become available. These steels fall into an intermediate position both as to alloy content and cost between plain carbon steel and the well-known 5% chromium 0·5% molybdenum alloy steel. Typical examples of this intermediate class, which are used mainly to fabricate seamless tubing for cracking furnaces, etc., are Croloy 2 and Croloy 3-M. The former alloy analyses 0·115% carbon, 0·4% manganese, 0·015% sulphur, 0·015% phosphorus, 0·40% silicon, 1·91% chromium and 0·51% molybdenum. The Croloy 3-M product contains 3·03% chromium and 0·90% molybdenum. Data are given for creep properties, thermal expansion, oxidation resistance, microstructure, impact strength and weldability. G. R. N.

1013. Metallurgical Aspects of Alloy Steel for Refinery Equipment. E. R. Johnson, C. C. Snyder and V. W. Whitmer. *Refiner*, 1937, **16** (3), 113.—The plain low-carbon steels (0·1%) are made either open or killed. The open type is used for general sheet or plate work. The type killed with silicon and aluminium is a uniform product, and in some cases is used for still tubes. These carbon steels are made in the open-hearth furnace (75–100 tons capacity). The ingots are reheated and rolled to the desired shape. The alloy steels containing copper molybdenum, nickel, chromium, etc., in small amounts up to 1–2% are well adapted to welding and general fabrication. They are made in either the open-hearth or electric furnace, depending on the requirements, and can be either open or killed, and are cast in ingots and rolled to various shapes. Semi-stainless steels contain generally more chromium than the SAE alloys (2–10% Cr) and may include 0·5% molybdenum to reduce age embrittlement and increase the creep strength. They are made in electric furnaces of the arc or induction type. The rolling practice employed on these intermediate chrome alloys is quite similar to the general alloy steels. They are chiefly used in still tubes, transfer lines, etc. The stainless steels may be divided into the straight chrome (12–14%) and the chrome–nickel (18 : 8) groups. The former are used as liners for reaction chambers, pump parts, valves, etc., whilst the latter have proved of excellent service for still tubes. They are made in the electric furnace, and subsequently suitably heated and rolled to develop the proper structure and physical properties. Heat-resisting alloys for furnace parts, tube supports, etc., are also made in the electric furnace, and contain up to 30% chromium in the straight chrome group and 25% chromium, 20% nickel or higher in the chrome–nickel group. A short discussion on piercing mills and on impact strength is given. G. R. N.

1014. Intermediate Alloy Steels for High-Temperature Application. S. D. Williams. *Refiner*, 1937, **16** (3), 117.—Alloy steels for refinery service now are being designed on an economic basis. Certain alloy additions are intended to increase corrosion or oxidation resistance rather than creep strength, for in some cases these qualities control the efficiency of the design as a whole. Chromium is used to provide corrosion resistance, silicon increases oxidation resistance, molybdenum acts to inhibit temper brittleness as well as to increase creep strength. In the 4–6% Cr–Mo steels small amounts of titanium or columbium act to prevent air hardening. The various Timken alloy steels are then described and tabulated data are given for a number of steels with regard to the effect of service temperature (900–1300° F.) on creep strength, oxidation resistance and oil corrosion resistance. G. R. N.

1015. Boiler Feed-Water Control. J. A. Campbell. *Refiner*, 1937, **16** (2), 60.—The writer gives evidence that indicates a steady dependable supply of dry steam at constant pressure is vital to operating a gasoline absorption plant at maximum efficiency, and goes on to describe the development of a boiler feed-water regulator

that was more sensitive and more positive than any then available on the market. The design adopted was the inclined thermostatic tube (42 in. long, slope 1 in 12). By appropriate distribution of fins at the cooler end it was found possible to increase the temperature difference of the tube ends considerably, making the tube two and a half times as sensitive as the simple tube. The cantilever method was employed to regulate the movement of the feed-water valve due to the change in water level in the inclined tube, the spread being such as to give a multiplication of 8. Installation of this type of regulator on nine boilers feeding an absorption plant resulted in an extraction increase of one-tenth of a gallon, or a production increase of 1200 gals. gasoline per day. G. R. N.

1016. Lubrite's Coke-Oven Units. J. C. Albright. *Refiner*, 1937, **16** (2), 23.—Owing to the seasonal variation in the fuel-oil market the Lubrite refinery at St. Louis installed a coke-oven unit to run surplus fuel to a saleable grade of coke, gasoline, gas oil and furnace oil, the last as demanded. The unit consists of four ovens, a pipe still, a bubble tower and an evaporator, and is so arranged that when it is not profitable to run to coke, the unit can be operated as a straight distillation unit by cutting out the coke-ovens. Bottoms from vapour-phase cracking units are charged to the bubble tower from which a residue stream is picked up and passed to the pipe still. The heated stream (870° F. and 100 lb.) is discharged into the evaporator, from which flashed vapours are taken to the bubble tower. A heavy viscous residuum collects at the bottom of the evaporator and constitutes the charge to the coke ovens, which are of the improved Knowles type. Stirring devices are arranged in the bottoms of both the bubble tower and evaporator to maintain solid particles in suspension. The ovens operate on a 6-hour cycle, being synchronized so that sixteen complete charges are made per 24 hours. A layer of coke about 8 in. thick is accumulated in each oven before the drying-out period is commenced. The discharged coke contains around 1% volatile matter and represents about 24% of the charge. Gasoline taken overhead from the bubble tower is about 7·5%, whilst a further 3·5% can be stripped from the gas produced. As much as 55·5% of low cold-test furnace oil can be produced as a suitable side cut from the bubble tower. Numerous details of the equipment are given. G. R. N.

1017. Monte Bello Gasoline Plant. Anon. *Refiner*, 1937, **16** (2), 66.—The chief features of this plant are the use of three vertical three-cylinder two-cycle gas-engine-driven compressors, arranged so they can be dismounted and trucked to another part of the field with minimum trouble, the use of shell and tube type oil coolers for the lubricating oil (forced feed) and the use of cleaners of the oil type, which utilize centrifugal force and washing, to remove abrasive material from the air going to the compression chambers. G. R. N.

1018. Operation of Special Columns in Gasoline Plant. Anon. *Refiner*, 1937, **16** (2), 85.—At the Grisso Gasoline Plant, Oklahoma, the Carter Oil Company operate a special fractionating unit in which practically any grade of natural gasoline as well as commercial grades of propane and butane can be produced. The average raw gasoline contains 3% ethane, 12% propane, 24% butanes, the remainder being pentanes and heavier. The fractionating equipment consists of three columns each equipped with its complement of exchangers, reboilers, reflux pumps, accumulators, etc. The charge is preheated by exchange and transferred at 250 lb. pressure to the first column. The overhead, taken at a reflux ratio of 25 : 1, is butane-free propane containing ethane, and is transferred to the second column, where controlled weathering at 235 lb. pressure and a base temperature of 110° F. give a bottom product of liquid propane, which is sent to pressure storage via a calcium oxide drier. The bottoms from the first fractionating column which are substantially propane-free butanes and heavier are transferred to the third column, operating at 120 lb., which gives liquid butane overhead (reflux ratio 6 : 1) and an 11-lb. natural gasoline as the bottom product. The average throughput of raw gasoline is 40,000 gals./day, which yields 25,000 gals. natural gasoline (11 lb. Reid), 11,000 gals. butane and 3000 gals. propane. G. R. N.

1019. Patents on Plant. W. Möhring. E.P. 465,927, 19.5.37. Improved apparatus for the distillation of high-boiling hydrocarbons to coke.

Stahlwerke Röchling-Buderus A.-G. E.P. 465,999, 20.5.37. Special alloys of Cr, Mo, Ti, Si, Mn and C for the construction of containers, sieves, pipes, etc., of plant which is subjected to the action of free chlorine or hypochlorous acid.

G. N. Preston and G.W.B. Elec. Furnaces, Ltd. E.P. 466,801, 7.6.37. Improved heat exchange apparatus, in particular, oil-coolers. W. S. E. C.

Corrosion.

1020. Soil Survey Record System for Pipe-line Corrosion Departments. D. Harrell. *Petr. Eng.*, May 1937, **8** (8), 36.—Records of measurements of soil resistivity are frequently vitiated by variations in the degree of water saturation of the soil. The system recommended consists in taking small samples of the soil, drying them at not more than 110° F., grinding and screening and making up standard solutions of 35 c.c. of this soil in 100 c.c. of distilled water. The ohm centimetre resistance of the solutions is determined with a Wheatstone bridge. The particular soil concentration was chosen as being just over the peak of the concentration resistivity curve. Records of the readings are kept together with full analyses of the soil. As a rule, soils with resistivity of over 2500 ohms per c.c. were found non-corrosive.

A full description of the electrical apparatus used in the resistivity measurements is given. C. L. G.

1021. Methods Employed in Protecting Pipe-line from Corrosion. J. C. Albright. *Petr. Eng.*, June 1937, **8** (9), 66.—Three types of coatings have been successfully laid on sections of a Californian pipe-line in areas of varying corrosivity. Grade A, for severely corrosive soils, consisted of five applications, viz. Dearborn 2C Primer, Dearborn XX No-oxid coating, 15 lb. asbestos wrapper saturated with asphalt, 21/30 pen. 155/175° F. m. pt. asphalt coating, and 30 lb. rag felt wrapper. Grade B, for bad to severely corrosive soils, consisted of three applications, viz. cutback asphalt primer, asphalt cover and 21/30 pen. 155/175 m. pt. asphalt coating. Grade C, for less corrosive soils, consisted of three applications, viz. cutback asphalt primer, asphalt cover and 30 lb. rag felt wrapper. In good soils no coatings were used. For railroad crossings the pipes were placed in redwood conducts filled with bitumen, grounds being placed in the soil and bonded to the pipe to lead away stray electrical currents. In very severe areas cathodic protection was applied with success.

C. L. G.

1022. Factors Causing Corrosion in Cracking Units. F. N. Newcomb. *Oil & Gas J.*, 27.5.37, **36** (2), 55.—The causes of corrosion in cracking plants include H_2S in the crude or formed by decomposition of sulphur compounds, HCl formed from chlorides, and water, particularly salt, used for cooling and condensing. The rate of corrosion varies, high temperature and high velocity accelerating the rate, whereas the presence of surfaces coated with coke reduces it. At 500° F. oil corrosion commences, but does not become excessive until 700° F. is reached. Thus the feed side of oil exchangers and the preheater tubes of the furnaces suffer only nominal corrosion, whereas the radiant and soaker tubes, transfer lines, reaction chamber, release line and separator will probably suffer quite severe corrosion, whilst parts of the bubble tower are also susceptible. The decomposition of sulphur compounds may cause corrosion at temperatures as low as 350° F. A further factor is the use of corrosion-resistant material in the hotter parts of the system, thus increasing the corrosion in the colder parts.

Methods of protection against corrosion include: (1) Use of special metals, *e.g.* KA2S (18·8 Cr–Ni steel) and 4·6% Cr–Mo steel for parts which cannot be lined or coated, *e.g.* tubes, headers, return bends, etc. These are 3–5 times as resistant to corrosion as carbon steel.

(2) Use in vessels of corrosion-resistant alloy linings which are an integral part of the steel or electrically welded to it, or linings of reinforced gunite, asbestos mud, etc. The former gives the best protection obtainable to-day, whereas the latter requires more or less frequent maintenance and periodic replacement.

(3) Metal spray coatings of *e.g.* aluminium, which give protection as long as they remain intact, but require constant maintenance.

(4) Injection of caustic soda and ammonia reduces the rate of corrosion, but frequently causes undesirable complications.

Frequent inspection should be made, particularly when operating conditions are changed, of vessels containing corrosive liquids, the most serious corrosion being at the liquid level, of vessels through which the vapours flow, particularly at the inlets, in piping, particularly at points of high velocity or turbulence, and in gate valves in the body between the seats. The inspection should include noting of any pitting, grooving, cracking, checking, scaling, bulging, etc., in which cases the depth of sound metal underneath should be determined. Attention should be paid to the condition of linings, to the supports of piping, coils, trays, pans, to the heads of rivets, to attached piping, nozzles, manholes, etc., and to exterior supports. Sounding with a hammer will indicate loose rivets, thin areas, etc. To avoid drilling holes to determine thickness of sound metal, corrosion-resisting buttons may be welded in and later removed, the extent of corrosion being determined from the height of the protected areas above the unprotected. Wall thickness may be measured with calipers or by taut wires inside and outside the vessel. Special calipers are available for the measuring of the thickness of tubes, header bores, return bends, etc. Hammer testing, if carefully carried out, will also indicate the thickness of tube walls. A method of indicating that wall thickness has been reduced to the safe limit is to drill small pointed holes on the outer wall to this thickness, corrosion beyond this extent being shown by leaks. Scraping of internal and external surfaces will indicate graphitization, and should be periodically tried out on all cast-iron equipment. C. L. G.

1023. Corrosion-Resistant Metals. F. N. Speller. *Refiner*, 1937, **16** (3), 105.—The author summarizes his views as follows: It is unlikely there will be one metal or one general remedy for corrosion. The combination of metal and environment should be chosen to give a reasonable return. This is essentially an economic problem, the answer to which may be to let the structure alone and recondition when necessary, as is often the practice in buried pipe-lines; to apply a coating of a more resistant material; to condition the environment so that it will be less active; or to select the metal or alloy best adapted to the particular conditions of service at the lowest consistent cost. Structural design, regulation of environment and care of metals are important factors in their life. Although they are susceptible to unfavourable environment, their resistance can be built up by inoculating them with alloying elements and by keeping their surfaces reasonably clean and free from foreign deposits. As the useful life of any metal is determined mainly by the film-building properties of both the environment and the metal, and as metals have to live under so many conditions of service, it is extremely improbable that any one metal can be made at reasonable cost that will meet all the common conditions of service. The problem of the engineer, therefore, is to select the metal that will best serve any specific purpose at the lowest ultimate cost. Too much attention may be given to first cost.

G. R. N.

1024. Magnesium Alloys. C. H. Desch. *J. Roy. Aer. Soc.*, 1937, **41**, 369–387.—An account is given of developments during the last three years in the production of light magnesium alloys suitable for aircraft construction. The heat treatment of castings and the hardening by ageing of forged alloys are considered, as well as the conditions affecting forging at various temperatures. The connection between these properties and the crystalline structure of magnesium is discussed.

The corrosion of magnesium alloys and the methods of combating this problem are outlined. Lanoline is occasionally used, but chemical treatments, such as the chromate, fluoride and selenium processes, are of more value, though only the chromate method is at present of commercial importance. Reference is made to the corrosion of these alloys by leaded fuels in the presence of water, which latter is necessary for corrosion to take place. The use of about 1% of quinoline as an inhibitor of the reaction, and of salts such as potassium fluoride as a preventive are briefly mentioned. Chlorides accelerate the corrosion of magnesium and its alloys and tend to break down any protective film on the surface. T. C. G. T.

1025. Oil Corrosion Problem. G. Egloff. *Refiner*, 1937, **16** (3), 99.—From the time that drilling for oil starts, clear to the use of gasoline in motor cars, corrosion of all types may be experienced in the oil industry. In the field, corrosion may be due to soil action, chemical and electrolytic, saline waters and hydrogen sulphide. In the refinery the main causes of corrosion are the end products, hydrogen sulphide and hydrogen chloride. Methods used to combat this corrosion include the injection of chemicals, calorizing, the use of alloy steels and the application of cements. Alloy steels are the most extensively used, and it is hoped that further research will reduce their present high cost. G. R. N.

1026. Copper and Copper Base Alloys. R. A. Wilkins. *Refiner*, 1937, **16** (3), 119.—An extensive account (with 117 references) aiming to present the characteristic corrosion-resisting and fundamental physical properties of copper, the brasses, the copper silicon alloys, the bronzes and the cupro-nickel and nickel silvers. Tabulated and graphical data are given on corrosion rate, tensile strength, elastic limit, elongation, hardness, melting point, density, coefficient of expansion, thermal and electrical conductivity. G. R. N.

Chemistry and Physics of Petroleum.

1027. Extended Vapour Pressure Chart for Hydrocarbons and Petroleum Products. E. S. L. Beale. *J.I.P.T.*, 1937, **23**, 311–315.—A previous chart (*J.I.P.T.*, Oct. 1935) has been extended to cover super atmospheric pressures to assist in fractionating column calculations. A modification is given to show how it can be used to adjust the b. pt. of residues for small pressure changes, as is required in the calculation of equilibrium temperatures. G. R. N.

1028. Alkylated Derivatives of Anthracene. E. Martin. *Ann. des Comb. Liq.*, 1937, **12**, 97–147.—This paper compares the chemical properties of the three series of hydrocarbons, dialkyl anthracenes, dialkyldihydroanthracenes and tetra-alkyldihydroanthracenes, with those of the mother-substance anthracene.

The hydrocarbons have been hydrogenated, brominated, oxidized and nitrated, and the results obtained are described.

Additionally the ultra-violet absorption spectra of certain of these hydrocarbons have been examined. W. E. J. B.

1029. Oxidation of Ethyl Mercaptan and Ethyl Disulphide by Bromine in the Presence of Water. H. A. Young. *J.A.C.S.*, 1937, **59**, 811–812.—Dilute carbon tetrachloride solutions of ethyl mercaptan and ethyl disulphide were oxidized to ethylsulphonic acid by bromine water, the oxidation requiring three and five moles of bromine per mole of the sulphur compound, respectively. Ethyl mercaptan is converted instantaneously and quantitatively to ethyl disulphide by dry bromine.
W. E. J. B.

1030. Rate of Oxidation of Ethyl Disulphide by Bromine. H. A. Young and M. B. Young. *J.A.C.S.*, 1937, **59**, 812–816.—The purpose of the work described was to investigate the addition compound formed when bromine and ethyl disulphide react, by measuring the rate of disappearance of bromine during the oxidation of ethyl disulphide in the two-phase system, consisting of bromine and disulphide dissolved in carbon tetrachloride as one phase, and bromine in water as the second.

The experiments were carried out at 25° C., and from the results obtained it has been shown that the initial rates of reaction are represented by the equation

$$-\frac{d\mathrm{Br}_2}{dt} = k \times (\mathrm{R_2S_2(Br_2)_2}),$$

where k is a function of the rate of shaking. The first steps in the oxidation in the presence of water are suggested to be

$$\mathrm{R_2S_2 + 2Br_2 \rightleftharpoons 2RSBr_2}$$

and

$$\mathrm{RSBr_2 + H_2O = RSO + \overset{+}{2}H + \overset{-}{2}Br}$$

W. E. J. B.

1031. Condensation of Acetic Acid and *cyclo*Hexene in the Presence of Boron Fluoride. H. L. Wunderly and F. J. Sowa. *J.A.C.S.*, 1937, **59**, 1010–1011.—The authors have studied the effect of boron fluoride on the formation of *cyclo*hexyl acetate from *cyclo*hexene and acetic acid.

The reactions were carried out at 80° C., and the reaction time was varied from 50 to 220 hours. The results indicate that a maximum yield of ester is obtained when the amount of boron fluoride used is about 10%; with higher concentrations of boron fluoride the quantity of residue obtained increased rapidly, indicating that polymerization was being effected. It was also found that one mole of boron fluoride was absorbed by one mole of ester.

The paper contains a suggested explanation for the change in the apparent equilibrium concentration of ester formed, with the quantity of boron fluoride used.
W. E. J. B.

1032. Estimation of *cyclo*Pentadiene and Indene and Their Polymerization in Carbon Tetra Chloride Solution. D. L. Hammick and D. Langrish. *J.C.S.*, 1937, 797–801.—The authors have found that dilute solutions (up to about $M/20$) of *cyclo*pentadiene and of indene in carbon tetrachloride absorb accurately and rapidly 2 atoms of bromine from excess bromine, also in carbon tetrachloride.

In the case of indene the amount of excess bromine must be controlled, to equal twice the calculated amount. The method is accurate to about 2–3%.

The polymerization of *cyclo*pentadiene in carbon tetrachloride follows a bimolecular law, but the polymerization of indene is a much slower process. The addition of the anti-oxidant acetonitrile diminishes the rate of polymerization of each of these hydrocarbons when dissolved in carbon tetrachloride. In pure acetonitrile no appreciable polymerization occurs; nor does it occur in carbon tetrachloride when oxygen is excluded. It appears, therefore, that polymerization is connected with the formation of peroxide in the solutions of the hydrocarbons, from which it appears that the polymerizations of *cyclo*pentadiene and indene are processes involving autoxidation. Confirmation of this view is found in the fact that solutions of *cyclo*pentadiene and indene, when prepared and preserved in an atmosphere of nitrogen, do not polymerize.
W. E. J. B.

1033. Improved Method for Synthesizing *iso*Butyl Ethyl Ether. E. M. Marks, D. Lipkin and B. Bettman. *J.A.C.S.*, 1937, **59**, 946–947.—These authors report a modification of the Cerchez synthesis for aliphatic ethers.

The original synthesis utilized the reaction between alkyl sulphates and magnesium alcoholates, in this case diethyl sulphate and magnesium *iso*butylate, and the present authors have obtained improved yields by substituting sodium for magnesium.

The experimental conditions for optimum results are detailed and the yield of *iso*butyl ethyl ether is stated to be 70%. W. E. J. B.

1034. Ethylene for the Production of Ethylchloride. Anon. *Chem. Trade J.*, 9.7.37, **101**, 23.—The greater availability at present of ethylene and other olefines has led to proposed methods for their conversion, in place of the alcohols, to alkyl chlorides. Such methods include reaction in the vapour phase in the presence of catalysts with HCl in a liquid medium in which the primary materials are soluble but chemically inert, and reaction of ethylene homologues with HCl in the presence of iron chloride, dissolved or suspended in a non-hydrolyzing liquid.

A method has been patented by E.I. du Pont de Nemours Co. (E.P. 466,134 of 1936) in which a gaseous mixture of C_2H_4 and HCl is passed into a suspension of *e.g.* anhydrous $AlCl_3$ in a chlorinated hydrocarbon with a b. pt. higher than that of ethyl chloride (*e.g.* trichlorethylene) at 20–60° C. under one atmosphere pressure. At the reaction temperature the ethyl chloride, but not the solvent, is vaporized. For propylene reaction ferric chloride is a more suitable catalyst. The vapours from the reaction are scrubbed with caustic alkali to remove acid and condensed under atmospheric pressure by cooling with solid CO_2. Yields of 91–100% of ethyl chloride of 95–98% purity have been obtained from ethylene. C. L. G.

1035. Complex and Unsaturated Naphthene Hydrocarbons. W. L. Nelson. *Oil & Gas J.*, 27.5.37, **36** (2), 161.—Little is known of the complex and unsaturated naphthene

hydrocarbons, which are the main constituents of lubricating oils. The data provided on typical complex naphthenes include: molecular structure, molecular weight, specific gravity at 60/60° F., boiling point, melting point, viscosity Saybolt Universal at 100° F. and 210° F. and viscosity index. On typical unsaturated naphthene hydrocarbons are given: molecular weight, specific gravity at 60/60° F., boiling point and refractive index. C. L. G.

1036. Separating Butenes from Butanes. M. P. Matuszak and F. E. Frey. *Ind. Eng. Chem. Anal.*, 1937, **9** (3), 111.—It was found that C_4 hydrocarbons form minimum-boiling azeotropic mixture with sulphur dioxide. The order of the azeotropes with respect to b. pt. is different from that of the hydrocarbons, viz. of *iso*butane — 24° C., *n*-butane — 18°, 1-butene — 16°, *iso*butene — 14°, 2-butene (*trans.*) — 14° and 2-butene (*cis*) — 13° C. The evidence for the existence of these azeotropes was obtained by carrying out distillations in a glass gas-analytical column, vacuum jacketed, the reflux condenser being cooled by ice-water. The course of the distillation was followed by the variation in column pressure. The sulphur dioxide content was lowest in the *iso*butane azeotrope and highest for 2-butene, also, in general, the hydrocarbon content decreased with increase in distillation temperature or pressure. The method was applied to two refinery C_4 gas fractions, and gave a very good separation. A study was then made of the equilibrium composition at various temperatures of both liquid and vapour mixtures of SO_2 and C_4 hydrocarbons in a suitably designed steel bomb. It was found that the SO_2 concentration was more than twice as high in the vapour as in the liquid for the sample containing the lowest SO_2 concentration in the liquid phase. This difference decreased as the SO_2 concentration in the liquid increased. 66 mol. % was the average or overall SO_2 concentration for all the possible azeotropic mixtures. The results of this equilibrium study are discussed with regard to the separation that may be effected in a fractionating column. G. R. N.

1037. Non-Flammable Dielectric Organic Compounds. F. M. Clark. *Ind. Eng. Chem.*, 1937, **29**, 698.—The non-flammable chlorinated cyclic hydrocarbons, such as the chlorinated derivatives of diphenyl compounds, are non-oxidizing, are of high dielectric strength and evolve only non-explosive gas mixtures when decomposed by the electric arc. The non-flammable dielectrics of the pentachlorodiphenyl type may be used, with advantage, in the manufacture of capacitators where the potential stresses are very high. The viscosity and pour point of dielectrics of the pentachlorodiphenyl type are high, and in order to enable compounds of this type to be used in lieu of transformer oils, it is necessary to dilute them with trichlorobenzene; the great stability and high dielectric strength are unchanged by this dilution.
J. W. H.

1038. Heats of Hydrogenation of Various Hydrocarbons. M. A. Dolliver, F. L. Gresham, G. B. Kistiakowsky and W. E. Vaughan. *J.A.C.S.*, 1937, **59**, 831–841.—This paper is a continuation of previous work by the above authors who have now determined the heats of hydrogenation of the following substances: Ethylbenzene, *ortho*-xylene, mesitylene, styrene, hydrindene, indene, *cyclo*pentene, α-terpinene, limonene, α-phellandrene, *iso*propylethylene, *neo*amylethylene, *tert.*-butylethylene, 2 : 4 : 4-trimethylpentene-1, 2 : 4 : 4-trimethylpentene-2, pentadiene-1,3, 2 : 3-dimethylbutadiene-1, 3.

The authors have now examined six representatives of the mono-substituted ethylenes, and, with the exception of the *neo*amyl group, the remaining five average 30,200 ± 100 calmole. The *neo*amyl group gives a lower result, and the suggestion previously made that branched-chain substituents are generally more effective in lowering the heat of hydrogenation can no longer be supported. It must be concluded that the introduction of branched chains near the double bond leads to heats of hydrogenation which cannot be so accurately represented by the simple rules postulated earlier as is possible with straight-chain alkyls. The data on the isomeric di*iso*butylenes also show this. With substituted conjugated dienes the introduction of alkyl groups also results in the lowering of the heat of hydrogenation, but the regularities are not very clear-cut.

As a general rule, benzene derivatives show a lowering of their heats of hydrogenation as compared with the parent substance.

The evidence of the heats of hydrogenation of the five-membered carbon-ring systems points to a strain which decreases as unsaturation increases. This is contrary to conclusions which may be reached from tetrahedal angle carbon atom models.

W. E. J. B.

1039. Thermal Decomposition of Ethane, Ethylene, Acetaldehyde, etc. M. W. Travers. *Trans. Faraday Soc.*, 1937, **33**, 735.—The thermal decomposition of simple organic compounds, such as ethane, is shown to involve three stages which are referred to as :—

(1) The background reaction.
(2) The main reaction leading to the formation of an unstable intermediate.
(3) The decomposition of the intermediate with formation of one or more products.

The pyrolysis was carried out in silica glass tubes and the temperature range 550–620° C., the tube being heated for a definite time, after which the contents were analysed.

In the case of ethane, the background reaction is the primary decomposition process, the final product being a mixture of methane and condensation products. For pure ethane the rate of formation of methane and condensate is represented by graphs curved towards the x-axis, and showing distinct breaks. It is suggested that the nature of the phenomena at the break-point may be due to changes in the gas phase—in this case the slowing down of one process appears to involve the starting up of another. In other cases the break-point seems to be associated with surface phenomena, and in these the limiting time at which the break occurs appears to be the half-life period. Up to the break-point the overall rate of charge, including reactions (1)–(3), can generally be represented by an equation $x = at^n$, which is characteristic of the graphs representing the thermal processes investigated, where a is dependent on concentration and n on temperature when effect of the background reaction is eliminated. By experimenting with ethane–ethylene–hydrogen equilibrium mixtures instead of with pure ethane, at temperatures at which equilibrium in this system is rapidly attained, it is found that the rate of reaction is represented by a simple bimolecular formula.

H. E. T.

1040. Thermal Decomposition of Propane, Propylene, Hydrogen Equilibrium Mixtures. M. W. Travers. *Trans. Faraday Soc.*, 1937, **33**, 751.—The thermal decomposition of equilibrium mixtures of propane–propylene–hydrogen has been studied at 553° C. At 553° C. the thermal reactions involving ethane and ethylene, which are products, are relatively slow, whilst those involving propane and propylene are relatively rapid. Propylene was prepared by decomposing *iso*butyl alcohol in contact with alumina, and propane by passing the propylene with excess of hydrogen, over asbestos coated with copper. Both gases were purified by liquefaction and fractionation. The reaction tubes were of Pyrex glass.

The main process which leads to the formation of the complex mixture of products, which result from the thermal decomposition of propane–propylene–hydrogen equilibrium mixtures, is a simple bimolecular reaction involving molecules of propane and propylene only. The reaction results in the formation of an unstable intermediate ($C_3H_8 \cdot C_3H_6$) from which the products are derived.

The three stages of the reaction may be represented by the equations

$$C_3H_8 = C_3H_6 + H_2$$
$$C_3H_6 + C_3H_6 = (C_3H_6 \cdot C_3H_6)$$
$$(C_3H_6 \cdot C_3H_6) = CH_4 + C_3H_6 + C_2H_4 + \text{condensate.}$$

H. E. T.

1041. Chemical Nature of Petroleum Gas Tar. N. A. Orlov, K. F. Protoyanova and V. P. Flegontov. *Khem. Tverd. Topliva*, 1936, **7**, 748.—Tar (sp. gr. 0·91), obtained by pyrolysis of various petroleum products at 700–800° C. was fractionated and the cut 160–200° C. was examined. The following compounds were separated : mesitylene, pseudo-cumene, hydrindene and $\beta\beta$-dinaphthyl. The 200–300° C. cut gave α- and

β-methylnaphthalenes, acenaphthene, dimethylnaphthalenes, phenanthrene and anthracene. Methods of separation are detailed. 30 references.

For. Petr. Techn.

1042. Effect of Promoters on Molybdenum Catalysts as Used in Hydrogenation. F. E. T. Kingman. *Trans. Faraday Soc.*, 1937, **33**, 784.—A description is presented of investigations carried out to determine the general effect of promoters on the catalytic activity of molybdenum compounds. The efficiencies of the catalysts were tested by measuring their activity in the conversion of phenol to benzene by hydrogen at atmospheric pressure, since this reaction is of some importance in the technical process for the hydrogenation-cracking of low-temperature tar, molybdenum catalysts being especially useful in the process. The chief results obtained were as follows :—

1. Under ordinary conditions of hydrogenation experiments, molybdenum trisulphide becomes more crystalline in character, and is converted to the disulphide with consequent loss in catalytic activity.

2. Ammonium phosphomolybdate is a good promoter for molybdenum trisulphide catalysts, and gives a very active catalyst. Experiments are described using a series of heteropoly compounds of molybdenum, and it is shown that phosphorus, silicon, copper, nickel and chromium enhance the activity, whilst tin and thorium depress it.

3. Determinations of absorptive capacities of the catalysts for carbon dioxide have been made. The results indicate that while a high surface area is essential for catalytic activity, tin and thorium increase the surface area of a catalyst, but depress its activity.

X-ray examination of the catalysts shows that they have the structure of molybdenum dioxide. In the phosphorus-promoted catalyst the effect of the promoter is to maintain a microcrystalline structure of the catalyst: other catalysts have a well-developed crystalline structure. H. E. T.

1043. Determination of Hydrocarbon Groups in Gasoline. M. I. Bykov. *Groz. Neft.*, 1936, **6** (7), 56.—It is stated there is a relationship between the surface tension and the refractive index of hydrocarbons which, for each group, is expressed by the constant $K = \frac{\sigma^{0.25}}{\left(\frac{n^2-1}{n^2-2}\right)}$, where σ = surface tension and n = refractive index. The difference in values of k for the various groups and the additive property of the relationship permit its application to the composition of straight-run or cracked gasolines. More figures for unsaturates and naphthenes are required to determine more accurate constants for these groups. Data on various crude oils are given.

For. Petr. Techn.

1044. Preparation of Acetaldehyde and Acetic Acid from Natural Gas. M. R. Lozovskii and S. M. Mendeleva. *Natural Gases, U.S.S.R.*, 1934, **8**, 59.—Acetaldehyde and acetic acid can be prepared from C_2H_2 containing pyrolysis products of methane by the hydration method in the presence of Hg–Mo–V catalysts at 254–262° C. The approximate yield is 15% of the acid. Check experiments indicated the catalyst worked satisfactorily in the presence of 2–3% oxygen in the gas. The vapour-phase catalysis of C_2H_2 to acetaldehyde required a larger contact volume. For. Petr. Techn.

1045. Acids and Bases from Cracked Gasoline. N. A. Orlov, V. Y. Kazakova and N. V. Churbakov. *Khim. Tverd. Topliva*, 1936, **7**, 944.—The mixture of acids from P.D. differs from those from straight-run distillate in its composition. It contains low mol.-wt. naphthenic and fatty acids. The naphthenic acids have 7–12 atoms of carbon, and among the fatty acids the presence of *iso*- and *n*-valeric acids and capronic acids was traced. Bases are mixtures mainly of hydrogenated homologues of pyridene and quinoline, and they differ from those separated previously by other investigators in their low mol.-wts. 20 references. For. Petr. Techn.

1046. A 100 Plate Glass Bubble Column and Still. J. H. Bruun and W. B. M. Faulconer. *Ind. Eng. Chem. Anal.*, 1937, **9** (4), 192.—The still described is the result of the senior

author's investigations on the construction of efficient laboratory fractionating equipment made in glass. The newly-designed bubble plate was employed, a hundred plates giving a column about 6·5 ft. high, the separating power being estimated from the trials as equivalent to that given by 72 theoretical plates. Distillate fractions are collected in receivers supported on a turn-table that can be electrically timed to change the receiver at any interval from 10 seconds to 2 hours. When distillation is started it is preferable to operate under total reflux for from 2 to 6 hours to ensure equilibrium is established. The reflux regulator can be adjusted so that the still can run at a low distillation rate for a day or more without attention. The efficiency of the apparatus was checked, using the binary mixtures heptane–toluene and ethylene chloride–benzene. G. R. N.

1047. Twenty Plate Laboratory Bubble-Cap Still. J. H. Bruun and S. D. West. *Ind. Eng. Chem. Anal.*, 1937, **9** (5), 247.—A laboratory still suitable for the preparation of low-boiling compounds of a high degree of purity, *e.g.* propane, is described. It consists of a glass still (one litre capacity) with a vacuum-jacketed Bruun laboratory column (80 cm. long) having twenty bubble-plates of the latest design. The vacuum jacket is surrounded by a brass cooling-jacket containing a mixture of CCl_4–$CHCl_3$ and solid CO_2. Receivers for the distillate consist of small pressure cylinders immersed in a Dewar flask. G. R. N.

1048. Laboratory Distillation and Vacuum Flash Unit. C. E. Winters and J. E. Hedrick. *Ind. Eng. Chem. Anal.*, 1937, **9** (4), 189.—A short account of a simple and inexpensive combination atmospheric and vacuum distillation laboratory unit designed to run continuously 4 litres per hour of crude. It can be used for the recovery of solvent from lub oil raffinates and extracts, as well as for the fractionation of lub itself. G. R. N.

1049. Absorption of Hydrogen in Liquid Reagents. D. T. Bonney and W. J. Huff. *Ind. Eng. Chem. Anal.*, 1937, **9** (4), 157.—After reviewing and criticizing proposed reagents, the authors describe the development in the use of a new reagent consisting of an aqueous solution of sodium anthraquinone 2 : 7-disulphonate and colloidal palladium peptized by sodium protalbinate. The summarized characteristics of this reagent are as follows. (1) It is the most active liquid known to the authors; with pure H_2 the absorption rate, in a suitable gas pipet, is about 15 mol. per minute. (2) It operates satisfactorily at room temperature. (3) H_2 may be determined accurately in the presence of N_2 and saturated hydrocarbons. (4) In routine analysis CO_2, unsaturates, oxygen and CO should be removed prior to the H_2 determination. (5) Although temporarily poisoned by CO and CS_2, the reagent regains its activity on standing in contact with oxygen or air. (6) H_2 and oxygen may be removed simultaneously. (7) The reagent appears to remain active after standing for several months, and seems to be unaffected by light. (8) The capacity is sufficient to take care of a number of determinations before revivification becomes necessary. The spent reagent is completely and simply revivified by contact with air or oxygen. G. R. N.

Analysis and Testing.

1050. Analyses of Ten Section and Greeley, California, Crude Oils. Anon. *Petr. Eng.*, May 1937, **8** (8), 122H.—Bureau of Mines analyses of the above crudes indicate that they are of wax-bearing, intermediate base of similar classification to Seminole and some of the Kansas fields. The Ten Section and Greeley crudes give the following yields of products respectively :—

Light Gasoline	14·1%, 8·8%.
(Total Gasoline and Naphtha	37·6% 33·2%.)
Kerosene dist.	4·3%, 10·5%.
Gas-oil	16·8%, 15·1%.
Non-viscous lub. oil dist.	6·8%, 8·7%.
Medium lub. oil dist.	4·5%, 6·8%.
Viscous lub. oil dist.	3·6%, 0·8%.
Residuum	21·3%, 22·7%.

The sulphur contents of the crudes are 0·37% and 0·28%—lower than that of most of the Californian crude oils. C. L. G.

1051. Gas Analysis by the Method of Desorption. K. Peters and W. Lomar. *Nat. Petr. News*, 2.6.37, **29** (22), 59.—Mixed gases are totally adsorbed on to active carbon. It has been found that, if the active carbon is then exhausted to a moderately low pressure, the adsorbed gases may be quantitatively and separately desorbed by raising the temperature in controlled increments. Temperatures can then be found at which a particular gas is liberated. At a temperature only a little below that critical temperature even very low pressures fail to liberate the particular gas. The analytical procedure for the estimation of H_2S, CO_2, C_2H_2, O, CO, N_2, A, Ne, He, CH_4, C_2H_6, C_3H_8, C_4H_{10}, C_5H_{12}, C_6H_{14}, C_2H_4, C_3H_6, C_4H_8, C_5H_{10}, C_6H_{12} and the total content of liquid hydrocarbons is given. The approximate composition of the gas is determined by ordinary methods of gas analysis, and sufficient gas is taken to yield 40–60 c.c. of hydrocarbons. The whole method is given in detail, and the procedure adopted in the analysis of coke-oven gas is also given. The quantitative determination of small amounts of H_2 in the presence of large amounts of hydrocarbon and of small amounts of hydrocarbon in the presence of excess H_2 are described. H. G.

1052. Physical and Chemical Constants of Gas Oils with Different Cetene Numbers. D. J. W. Kreulen. *J.I.P.T.*, 1937, **23**, 253–265.—A paper giving data and analyses of eleven mineral gas oils varying in cetene number between 23·5 and 65. The analyses, which are discussed, include density, mol. wt. refractive index, dispersion, surface tension, diesel index, elementary analysis, viscosity and bromine number. G. R. N.

1053. Measurement of Oil in Bulk. W. F. Jelffs. *Petr. Times*, 12.6.37, **37** (961), 794.—International agreement on methods of calculating and expressing bulk oil quantities is sadly lacking in uniformity. A plea is made for expression in terms of weight at an agreed standard temperature. The methods at present in use are discussed critically. It is estimated that if all due precautions and care are taken an accuracy of 1½ parts per 1000 may be achieved. H. G.

1054. Determination of Lead in Motor Fuel. W. N. Epler. *Refiner*, 1937, **16** (2), 83.—100 mls. each of the sample and kerosine are cooled in a 600-ml. beaker by means of an ice-bath. Bromine is added until a permanent brown colour is produced. The lead bromide is filtered off on a Gooch crucible, which is transferred to the original beaker and 100 ml. of 10% nitric acid, together with a few ml. of concentrated nitric acid, are added. The acid solution is boiled to dissolve the lead bromide and the crucible is removed, being washed out with distilled water during removal. The solution is carefully evaporated to dryness, then the lead nitrate is taken up with 75 ml. distilled water and filtered from asbestos fibres (washed with 25 ml. distilled water). Dilute ammonium hydroxide is added until just alkaline, then dilute acetic acid until just acid. 15 ml. of *N*/10-potassium dichromate are next added and the solution is heated until the precipitate collects in large crystals. The solution is filtered and the excess of *N*/10-potassium dichromate over that required to precipitate the lead is estimated volumetrically, using iodine and thiosulphate. Analytical details are given. G. R. N.

1055. Principle of the Suspended Level. L. Ubbelohde. *Ind. Eng. Chem. Anal.*, 1937, **9** (2), 85–90.—In Ostwald-type viscometers the pressure driving the liquid through the capillary is decreased by the upward pull owing to the surface tension of the liquid in the upper reservoir. It is also difficult to determine accurately the head under which the liquid moves. In the new design of viscometer the recumbent liquid level in the lower reservoir is replaced by a suspended level in the form of a hollow hemisphere at the lower end of the capillary, by allowing the capillary to discharge into an air space. This eliminates the uncertainty regarding the position of the lower liquid level and balances the effect of surface tension at the upper meniscus. The dimensions of the instrument are so arranged that after the correction for kinetic energy of flow is applied, the time of flow multiplied by a power often gives the kinematic viscosity directly in centistokes. Other apparatus using the suspended level

principle are described for measuring surface tension by capillary rise and for the simultaneous measurement of static and dynamic surface tension. G. R. N.

1056. Determination of the Aniline Point of Dark Petroleum Products. L. Donn. *Ind. Eng. Chem. Anal.*, 1937, **9** (5), 202.—Equal parts by vol. of dry distilled C.P. aniline and the sample are introduced into an Ostwald viscometer (outflow time = 15 secs. for 5 ml. water at room temperature), which is placed in a bath at a temperature high enough to ensure complete solution. The oil–aniline mixture is agitated by applying gentle suction to the wide end of the viscometer. The bath is allowed to cool slowly, and relative viscosity readings are commenced and continued as rapidly as possible during the cooling period. The outflow time steadily increases with the fall in temperature to a maximum, then decreases with the temperature through a comparatively long period. It was found that the temperature corresponding to the maximum outflow time corresponded very closely with the aniline point of the sample by the I.P.T. method. A smooth rate of cooling of about 1° C. in 5–10 minutes was found to be satisfactory. G. R. N.

Motor Fuels.

1057. High-Octane-Number Blending Stocks Produced by Solvent Extraction. A. Saegebarth, A. J. Broggini and E. Steffen. *Nat. Petr. News*, 2.6.37, **29** (22), 51; *Refiner*, 1937, **16**, 256.—Straight-run gasolines from a widely differing variety of crudes have been extracted with liquid SO_2, at temperatures between 0° and minus 60° F. to produce extracts with high blending octane numbers. Octane numbers between 80 and 100 have been obtained, the figure depending largely on the temperature at which extraction is carried out. Lower temperatures produce higher octane numbers. The freedom from gum and the marked stability exhibited by these extracts make them particularly suited for aero-engine fuels. They also possess high Kauri–Butanol numbers, and are therefore in wide use in the lacquer and varnish industries. A semi-commercial plant used in the experiments which are described is dealt with and operating costs are given. H. G.

1058. Treating Cracked Gasoline Containing Sulphur. J. C. Albright. *Petr. Eng.*, May 1937, **8** (8), 108.—A description is given of an acid-treating plant for cracked gasoline containing up to 0·63% sulphur, installed at a Santa Fe Springs, Calif., refinery. Laboratory experiments showed the necessity of low treating temperatures, short contact time and early separation of the sludge (prolonged contact with sludge causing rising temperature with the evolution of SO_2 and formation of refractory sulphuric esters). Pressure distillate is filtered and passed to a three-stage chilling, contacting and centrifuge unit, in the final stage of which it is treated with 98% H_2SO_4 at temperatures down to 20° F. The contact equipment is arranged to give a contact period of 1 second only, the treated distillate after each stage being passed to centrifuges, where within 4 seconds the sludge is removed. After water-washing, the distillate is soda-treated in a similar two-stage contact and centrifuge unit. A further water wash follows, and the treated distillate, which is now at 55° F., is heat-exchanged to 150° F. and heated in a pipe-still to 385° F., whence it passes to a fractionating column. If necessary a doctor treatment is given to the finished gasoline. Using 13·6 lb. acid per brl., the sulphur content is reduced from 0·63% to 0·18% at an overall yield of 92·4% of finished gasoline. C. L. G.

1059. Liquid Fuel Problems in Germany. O. Ruhl. *J. Fuel Soc. Japan*, 1937, **16** (175), 33.—An account is given of the development and commercial operation of the Bergius and Fischer–Tropsch processes in Germany. It is indicated that Japan is in a similar position with regard to the liquid fuel problem, and therefore the development of these processes and of low-temperature tar distillation is of particular interest. G. R. N.

1060. Relative Knocking Characteristics of Motor Fuels in Service. J. M. Campbell, W. G. Lovell and T. A. Boyd. *J.S.A.E.*, 1937, **40**, 144–148.—The so-called "appreciation" and "depreciation" of motor fuels in different cars relative to the knocking

tendencies as measured in laboratory test engines are dependent on the type of reference fuels used. The authors discuss fuel factors affecting "depreciation," and show how with the straight-run reference fuels at present so widely used it is possible to vary the rating of highly cracked fuels merely by a change in automatic ignition setting, so making the maximum knock on the car occur at high or low speed.

The air/fuel mixture ratio is another factor greatly affecting "depreciation" of cracked gasolines, and reference is made to a test where altering the ratio from 14–1 to 11–1 "depreciated" the fuel rating from 80 to 74½ octane. This result agrees with Uniontown results on similar fuel, where the mixture ratio on the cars was from 11 to 12–1, and lower ratings were obtained than on C.F.R. Research Method, which was run at maximum knock of approximately 14–1 ratio.

An explanation is suggested of the anomalous behaviour of benzol blends which almost invariably give better results in road tests than would be expected from conventional laboratory ratings. It is contended that benzol, which is a relatively volatile fuel, tends to vaporize with the light ends of the fuel on acceleration, and thus at the beginning of acceleration a fuel mixture rich in anti-knock properties is delivered to the cylinders. Two fuels of equal C.F.R. ratings were prepared to test this theory, viz., a benzol blend in straight-run fuel of low anti-knock, and a blend of ethyl ether in straight run fuel of high anti-knock. On the road the first of these fuels "appreciated" 3 octane numbers and the other depreciated 4 octane numbers in terms of the two straight-run fuels used as reference fuels.

The instances where straight-run fuel containing tetraethyl lead are known to give low road ratings in comparison with laboratory ratings against the same reference fuels are explained. The volatility of the anti-knock agent appears to be the governing factor. Two fuels with the same C.F.R. rating of 76 octane number were made up, one with lead tetramethyl and one with tetraethyl lead. The former is much more volatile than the latter. The average road rating of the former in three cars was 81, whilst the latter gave an average figure of 71, and it is believed this difference is accounted for by the varying volatility of the anti-detonants. This belief is further supported by the fact that the effects were observed on low-speed knock, and also that the differences could be practically eliminated by applying extra heat to the induction.

C. H. S.

1061. Carbon Monoxide in Engine Exhaust Using Alcohol Blends. L. C. Lichty and C. W. Phelps, *Ind. & Eng. Chem.*, 1937, **29** (5), 495.—The tests described were conducted on a C.F.R. engine and a six-cylinder Chevrolet engine. Gas analyses were obtained using the Orsat apparatus, and in some cases a Cities Service power prover; air consumptions were obtained on the C.F.R. engine with a large gas-meter, and on the Chevrolet engine with an orifice meter or the power prover.

Tests with gasoline, and blends containing 10% and 20% ethyl alcohol in gasoline showed that the amount of carbon monoxide in the exhaust gases increased as the air–fuel ratio was reduced, and was practically independent of the fuel at mixture strengths comparable with regard to the theoretical air requirements of the particular fuel.

At maximum power mixture strengths, about 2·7% and 3·8% carbon monoxide was found in the exhaust of the single-cylinder engine (C.F.R.) and the six-cylinder engine (Chevrolet), respectively, regardless of the fuel used. No appreciable carbon monoxide was found if more than the theoretical amount of air required for complete combustion was present.

The almost complete elimination of carbon monoxide from the exhaust gases of the Chevrolet engine at full load was possible only by weakening the mixture strength to such an extent that a reduction in the power output of 6% was effected.

Variations in carbon monoxide from individual exhaust ports indicated, for the fuels studied, that factors other than fuel characteristics were the more important in influencing distribution of fuel and air in the induction system.

The danger of inhaling air contaminated with exhaust products is stressed and attention is directed to the fact that crank-case fumes are also dangerous.

J. G. W.

1062. Patents on Motor Spirit. Edeleanu Co. E.P. 467,048, 10.6.37. Extraction of light oils with SO_2 to produce an anti-knock agent for motor fuels or a lacquer solvent.

C. Ellis. U.S.P. 2,079,607, 11.5.37. Preparation of anti-detonant fuels and synthetic resins by cracking hydrocarbon oils. The resins are obtained by reacting on the motor-fuel constituents with a phenol in the presence of a catalyst.

L. H. Fitch, Jr., and F. E. Frey. U.S.P. 2,079,934, 11.5.37. Catalytic treatment of gasoline with solid adsorbent material to remove sulphur and gum-forming constituents.

G. H. von Fuchs and L. E. Border. U.S.P. 2,080,365, 11.5.37. Sweetening of liquid hydrocarbons containing mercaptans by means of an active copper reagent in the presence of ammonia.

R. B. Day. U.S.P. 2,080,701, 18.5.37. Refining of light distillates by treating them with aqueous hydrochloric acid and then vaporizing the oil and contacting the vapours with copper or zinc.

J. C. Morrell. U.S.P. 2,080,732, 18.5.37. Refining of light hydrocarbon distillates in the vapour phase with H_2SO_4 containing an aromatic aldehyde as a spacing agent.

D. B. Nutt and J. H. Easthagen. U.S.P. 2,080,737, 18.5.37. Removal of H_2S from petroleum diaillates by treating them with an aqueous alkaline solution and solid insoluble materials.

W. A. Schulze. U.S.P. 2,081,309, 25.5.37. Stabilizing volatile petroleum distillates which have been sweetened with copper chloride against catalytic deterioration by bringing the oil in the liquid phase into contact with an adsorbent carrier material impregnated with an aqueous solution of sulphides alkali or alkaline earth metals.

V. N. Ipatieff. U.S.P. 2,081,357, 25.5.37. Improvement of cracked gasoline by the addition of an alkylating agent and passing the olefinic substances in the vapour form into the resultant mixture. The gasoline containing alkylated aromatics is separated from the alkylating agent. W. S. E. C.

Gas Oil, Diesel Oil and Fuel Oils.

1063. Aviation and Diesel Fuels by Extraction and Hydrogenation. A. L. Feigin, O. S. Obleukhova and A. G. Prorokov. *Neft. Khoz.*, 1936, **3**, 57.—Light and heavy gas oil ex Balakhany crude and P.D. ex Surakhany topped crude were treated with 50% spent furfural, then with 50% fresh furfural at 20° C. The heavy gas oil had a 19·7% lower induction period and an increase in cetene number by 8·5 units, whilst the light gas oil and cracked kerosine had a cetene number which was higher by 12 units, and the P.D. had a lowering of the induction period by 14·8%. The extracts are mainly aromatic (aniline point — 10° C.) and can be converted to aviation fuel by hydrogenation. For. Petr. Techn.

1064. Patents on Fuel Oil. V. Voorhees. U.S.P. 2,079,887, 11.5.37. Production of high cetene diesel fuel from products obtained by cracking wax—these products undergoing subsequent catalytic polymerization. W. S. E. C.

Lubricants and Lubrication.

1065. Microdetermination of Viscosity of Lubricating Oil. H. Levin. *Ind. Eng. Chem. Anal.*, 1937, **91** (3), 147.—The method is based on the rate of rise of the sample in a clean vertical fine capillary, which, for the samples examined, was found to be directly related to the absolute viscosity. The capillary tube (drawn from a 30 cm. length of 1 mm. bore) had a working length of 8 cm. and a substantially uniform bore of 0·17 mm. Marks were etched at 25 mm., 38 mm. and 51 mm. from the lower end. The sample was drawn into a marked delivery pipette and transferred to a small hollow metal cone (the oil reservoir) fixed together with the capillary viscometer and a thermometer in a test-tube (as an air bath). The latter was then placed in a Vogel–Ossag thermostat and the time taken for the oil to rise by capillarity to each of the

three marks, commencing from the time at which the capillary end touched the surface of the oil in the reservoir. The time taken to reach the middle mark (38 mm.) was used to obtain the absolute viscosity by reference to a curve. A 5-mgm. sample of oil proved to be ample for the test. G. R. N.

1066. Four-Ball Top for Testing the Boundary Lubricating Properties of Oils Under High Mean Pressures. G. D. Boerlage and H. Blok. *Engineering*, 1937, **144** (3729), 1.—The apparatus described and known as the "Four-Ball Top" is similar in principle to the four-ball apparatus for testing extreme pressure lubricants. The balls used are ordinary hardened steel ball bearings, three of which are fitted tightly in a cup which is not free to rotate; the fourth ball is fitted in a weighted arm and makes three "point" contacts with the lower balls. The arm can be given a definite initial angular velocity, and, from the number of revolutions before coming to rest and the time taken, the coefficient of friction can be determined.

The instrument has been designed particularly for the purpose of testing boundary lubricating properties at pressures of 10,000 kg. per sq. cm. and higher, and at low sliding speeds of 0·1 cm.–1·0 cm. per second.

The authors consider that very high pressures are necessary in a testing machine, since in practice, even with highly finished surfaces, the load is carried by a number of points which are subjected to a very high pressure, even though the mean pressure is low.

The Four-Ball Top machine is designed for testing oils at controlled temperatures up to 300° C.; it is stated that the frictional heat developed during a test is small and does not appreciably affect the temperature of the oil film between the points of contact of the balls.

It was found from tests using the Four-Ball Top that in general the greatest differences between lubricants became apparent in the region of temperature above 100° C. Fatty oils at room temperature showed slightly less friction than mineral oils at normal load, but the breakdown temperature was lower for the former. The addition of dopes reduced the coefficient of friction of mineral oils at low temperatures, but also reduced their ability to stand high temperatures.

Some work on combinations of bronze and steel balls is described. J. G. W.

1067. Synthetic Lubricating Oils—V. A. D. Petrov, E. N. Pitakhelauri and E. I. Erzyutova. *Khim. Tverd. Topliva*, 1936, **7**, 890.—The preparation of lubricating oils by the voltolization method was studied to obtain oil with a viscosity and other constants equal to those of the American oils X and Y. The "vapour-T" and "cylinder-6" oils (d 0·9191 and 0·9396; E_{100} 6·67 and 5·6; Conradson 5·46 and 4·09) were subjected to the action of A.C. current of a frequency of 1000 or 50 Hertz. The reaction chamber (voltolizer) was water-jacketed (glass), in which the temperature was regulated (10–90° C.): the pressure in the chamber was kept within 8–10 mm. Hg. Water circulating through the jacket and an aluminium rod placed in the centre of the reaction chamber served as electrodes. An electrolytic H_2 (freed of O_2) was used to form gaseous emulsions. The load varied within 3 to 350 w., and the potential within 3000–6000 v. The formation of clots on the aluminium electrode decreased with increase of temperature and increased with increase of the intensity (power) of the voltolization. As a first approximation the rate of polymerization was found to be: $tg\alpha = \Delta M/\Delta\tau$, where $tg\alpha$ is the velocity, ΔM the increase in mol. wt. and $\Delta\tau$ the amount of electrical energy consumed. The increase of the velocity of the reaction, together with the intensity or density of the electro-ionic flow, shifts to the cracking side, which is shown by a discontinuation in the increase of the mol. wt. The increase of the latter is accompanied by an insignificant increase of the amount of unsaturates as shown by the iodine number. The Conradson value of the oil was practically the same as that of the initial oil if the process was carried out without a noticeable amount of cracking. Slow polymerization of the oil at an intensity of voltolization of 20 w. and a temperature of 80° C. yielded a high-grade viscous oil. To determine the heat stability of the natural and voltolized oils in steam engines, they were cracked in a rotating Bergius autoclave at 350°, 400° and 450° C. under a steam pressure of 100 atmos. It was found that the "vapour-T" and "cylinder-6" oils after voltolization were more stable than the imported oils "X" and "Y," since they gave less gaseous products on cracking. For. Petr. Techn.

1068. Use of Addition Agents in Motor Oils. C. M. Larson (reported). *Nat. Petr. News*, 12.5.37, 29 (19), 72.—In a series of engine tests carried out on an aero-engine and a caterpillar diesel test engine, three Pennsylvanian oils (120 sec. S.U. at 210° F.) have been examined. One was (*a*) a highly filtered oil with a carbon content of 1·06, the second (*b*) a solvent refined oil, carbon content 0·51, from the same crude, and the third (*c*) a highly solvent refined oil with an addition agent. The efficiency of the oils was assessed by an examination of the engines after standard running times when the oils were placed in the following order of decreasing efficiency *c*, *a*, *b*. This rating is not in line with the results of the usual laboratory tests. It is suggested that the tests indicate that the use of addition agents is now essential for high-duty engines, and that their use will become general for all classes of engine. Some corrosion problems will be concomitant with the use of addition agents, and there will be need for some modification of bearing-metal composition. The discrepancy between laboratory test and engine-test ratings emphasizes afresh the need for still other tests if the engine test cannot for any reason be applied. H. G.

1069. Addition of the Products of Electronization to Mineral Oils. M. Roegiers. *Petr. Times*, 12.6.37, **37** (961), 814.—Electrion R is a viscous oil produced by the De Cavel and Roegiers process, and is used as an addition agent to mineral oil to increase viscosity index and oiliness and retard sludging in service. As a particular example 5% of the dope added to an oil of viscosity 135 seconds Redwood at 140° F. and V.I. minus 10, increases the latter to 45. A No. 1 Russian oil which produced an appreciable sludge on being heated for 24 hours at 300° F. yielded none in 300 hours after the addition of 10% electrion R. The material never increases the pour-point of the oil to which it is added, and usually lowers it. H. G.

1070. Modern Lubricating Oil Unit. A. L. Foster. *Nat. Petr. News*, 9.6.37, **29** (23), 50.—In the plant described, Smackover crude, after being washed to remove salts and naphthenic acid, is first stripped to give a residue which will yield, by further treatment, lubricating oils of the required flash-point. This stripping is accomplished by passing the crude through the convection section of a tube still and flashing, with steam, in an evaporator. The residue then passes to the radiant section of the still and is flashed under wet vacuum in the tower from which the lubricating oil fraction, amounting to 27–28% of the crude, is taken overhead without further stripping. This distillate is then fractionated into six S.A.E. grades in a unit consisting of six tubular drip-type heating units in which the heating is indirect by oil heated, in closed circuit, in a separate tube unit. The resulting oils are claimed to be of exceptional quality, although to what extent this may be due to the method of refining or to the particular properties of the crude is not clear. H. G.

1071. Lubrication of Journal Bearings in Oxidizing Conditions. C. Jakeman and A. Fogg. *J.I.P.T.*, 1937, **23**, 350–366.—The N.P.L. journal friction machines were used to determine whether the improved performance obtained by prolonged running of a journal bearing in oxidizing conditions was due to oxidation of the lubricant. The experiments showed that the improvement was due to changes in the form of the bush and in the quality of the running surface only. G. R. N.

1072. Engine Temperature as Affecting Lubrication and Ring Sticking. C. G. A. Rosen. *J.S.A.E.*, 1937, **40**, 165–172.—In this article the author deals with some of the more important factors having direct influence on ring-sticking. A number of experiments were conducted with several types of piston crowns, and design structures adjacent to the combustion chamber, from which it was concluded that the temperatures of these parts have a profound influence on the tendency to form deposits. In exploring the influence of liner, piston and ring design, and the effect on the rubbing surfaces of the type of metal and the machining finish, it was found that ring scratching accelerated ring sticking by causing the particles abraded to seize the ring in its groove. It was therefore apparent that raw machined surfaces must be transformed to a condition capable of maintaining a suitable oil film. Furthermore, the design of parts adjacent to the combustion chamber must permit of a temperature gradient conducive to proper

distribution of lubricant, and allow of good oil flow to effect flushing of the products of decomposition. As regards "breaking in," it was found that a suitable additive had the effect of reducing the wear after 14 hrs. breaking in and subsequent 1000 hrs. running to 28% of that experienced on another similar engine in which the lubricant was not so treated.

A single-cylinder diesel was designed especially to enable rapid examination of its parts to be made after test runs. On different units of this design, experiments showed that the time required to stick rings varied from 100 to 3000 hrs., with oils all considered suitable for diesel engines. When the rings stuck, the blow-by increased from the normal 12–20 cu. ft. per hr. to 85 cu. ft. per hr., at which point the test was stopped. It was found that these lubricants could be classified in three groups related to methods of refining and finishing. Photographs are given showing the effect of temperature on various types of oil.

A number of tests for oxidation and coking were made on test-bars subjected to a controlled heat gradient, and although the results did not agree perfectly with engine results, much valuable information was obtained by this method. Tests on compounded oils have shown that by their use cylinder wear can be greatly reduced. With the single-cylinder engine mentioned a normal rate of cylinder wear at the top ring is from 0·0025 to 0·004 inch. per 1000 hrs. With some mineral oil this figure has reached 0·009 to 0·011 inch., whilst compounded oils have given figures as low as 0·0003 to 0·0005 inch per 1000 hrs. C. H. S.

1073. Piston Ring Friction. G. J. Hawkes and G. F. Hardy. *Rev. Comb. Liq.*, November 1936. **14** (139), 308–318. (Paper read before N.E. Coast Inst. of Engineers and Shipbuilders). Various experimental studies were undertaken at Armstrong College in order to determine the influence of oil, temperature, piston speed, gas pressure behind the piston rings, and the number of rings, on the frictional resistance between the piston rings and the cylinder wall.

The following conclusions are reached based on speeds below 3353 m./s. Plentiful lubrication reduces friction. At speeds above 0·610 m./s. the friction of a ring varies as the square root of the viscosity, and approximately also as the square root of nett radial load of each ring. Although there does not appear to exist a relation between friction and piston speed, it has been shown that when the surface has not an alternating movement, and under conditions of a normal load of 3515 kg./cm.^{2} and abundant lubrication, the frictional resistance remains approximately proportional to the square root of the speed up to speeds of 12,192 m./s. In the case of an alternating movement the average frictional resistance is influenced by conditions at "dead" spots, but less so at greater than at lower speeds. At constant air pressure the drop occurs entirely at the last ring, which offers also the greatest resistance to friction. However, in a motor cylinder there is a great fall of pressure even at the first ring, depending on the speed and number of rings used, and which increases with the speed of rotation, all other things being equal. In simple motors of low-speed lubrication of the top ring is uncertain, and as the pressure drop at this point is greatest, the frictional resistance is appreciably greater than the average value encountered along the course of the piston. This explains why the greatest wear is found on the dead spots of the cylinder wall. Experiments when the piston was suspended freely and without lateral movement showed that, contrary to the opinions held by certain authors, the frictional resistance in a motor is not only attributable to the friction of the piston due to lateral pressures, but the friction of piston rings themselves is not negligible.

In a motor cylinder, owing to the variation of pressure, leaks occur at all the rings, resulting in contamination of the oil by the burned gases, round every ring, which tends to increase the frictional resistance: The experiments have also shown the advantage of using narrow rather than wide rings, the importance of a careful adjustment of the last ring, and the importance of the good-wearing qualities of the horizontal surface of the groove on which the ring presses. M. M. L.

1074. Patents on Lubricating Oil. Standard Oil Development Co. E.P. 465,825, 11.5.37. Preparation of stable lubricating compositions by blending a phenolic compound with a hydrocarbon lubricating oil base stock and a preformed thickened oil, *e.g.* voltolized rape-seed oil soluble in such hydrocarbon oil.

Standard Oil Development Co. E.P. 466,075, 21.5.37. Lubricant containing a hydrocarbon oil and a small quantity of an esterified diphenol thio-ether.

E. A. Evans and C. C. Wakefield and Co., Ltd. E.P. 466,166, 18.5.37. Removal of sludge from surfaces of lubricating systems, oil coolers and separators, etc., by treating the surface with tetrahydronaphthalene admixed with a fluid vehicle.

Standard Oil Development Co. E.P. 466,619, 1.6.37. Preparation of a lubricating grease from a lubricating oil, a lime soap and a high-m.pt. wax. Calcium sulphonate and butyl furoate are also added.

N.V. de Bataafsche Petroleum Mij. E.P. 466,730, 3.6.37. Process for extracting liquid mixtures consisting of three components by means of selective solvents.

E. Petty and M. B. Cooke. E.P. 466,731, 3.6.37. Deasphalting and dewaxing of hydrocarbon oils in separate stages.

Edeleanu Co. E.P. 466,977–466,980, 9.6.37. Processes for solvent refining of hydrocarbon oils.

I.G. Farbenindustrie, A.-G. E.P. 466,996, 9.6.37. Production of high-quality lubricating oils by polymerizing ethylene or gaseous mixtures containing ethylene in the presence of anhydrous aluminium chloride in an inert solvent.

Standard Oil Co. of Calif. and C. H. Mellersh-Jackson. E.P. 467,090, 7.6.37. Improvement of lubricating oil by the addition of 2% of a basic metal salt of petroleum naphthenic acids.

T. A. Petry. U.S.P. 2,079,035, 4.5.37. Solvent extraction of hydrocarbon oils using benzylamine.

N. G. de Rachat. U.S.P. 2,079,158, 4.5.37. Refining of lubricating oils with absorbent material.

E. Petty and K. Finsterbusch. U.S.P. 2,079,182, 4.5.37. Propane dewaxing of hydrocarbon oils.

S. C. Fulton. U.S.P. 2,079,443, 4.5.37. Refining of lubricating oils with sulphuric acid.

J. A. Alexander. U.S.P. 2,079,596, 11.5.37. Separation of oil and wax mixtures.

A. A. Wells. U.S.P. 2,079,782, 11.5.37. Deodorizing of lubricating oils by treating them with clay at or above 200° F., separating the clay and then agitating the oil with moist SO_2 below 200° F.

V. Voorhees. U.S.P. 2,079,885–2,079,886, 11.5.37, and P. C. Keith, Jr., and H. O. Forrest. U.S.P. 2,079,911, 11.5.37. Solvent extraction of lubricating oils using propane.

M. Mizuta and T. Yoshimura. U.S.P. 2,080,087, 11.5.37. Refining of cracked oil by adding a solution of an oil-soluble heavy metallic soap of abietic acid in a volatile organic solvent. The precipitated mercaptans are then separated.

F. R. Moser. U.S.P. 2,080,088, 11.5.37. Lowering pour point of lubricating oils by adding condensation products of SO_2 soluble mineral oil extract.

S. W. Ferris. U.S.P. 2,080,415, 18.5.37. Improvement of lubricating oil by fractional extraction with quinoline.

C. Ellis. U.S.P. 2,081,174, 25.5.37. Deasphalting and dewaxing petroleum oils using propane and phenol.

R. J. Garofalo and C. E. Swift. U.S.P. 2,081,297, 25.5.37. Preparation of lubricating oil for dewaxing by mixing with the oil an asphalt fraction recovered from a used crank-case oil.

R. N. Giles. U.S.P. 2,081,397, 25.5.37. Improved filter system for dewaxing.

H. O. Lindgren. U.S.P. 2,081,403, 25.5.37. Dewaxing of lubricating oils using trichlorethylene.

U. B. Bray and C. E. Swift. U.S.P. 2,081,473, 25.5.37. Propane deasphalting of lubricating oils.

D. R. Merrill. U.S.P. 2,081,494–2,081,495, 25.5.37. Solvent extraction of lubricating oils using dichlorethylether.

D. R. Merrill. U.S.P. 2,081,497, 25.5.37. Solvent extraction of lubricating oils using SO_2 and benzene.

D. R. Merrill. U.S.P. 2,081,498, 25.5.37. Solvent extraction of mineral oils containing acidic constituents by treating them with alkali to convert the acidic constituents into salts which do not react with the solvent and extracting the alkali-treated oil with a selective solvent.

M. L. Wade. U.S.P. 2,081,519, 25.5.37. Dewaxing of petroleum oils in which Montan wax is added first and then one of the following: cracked petroleum pitch or extract from same, cracked petroleum distillate and polymerization product obtained by voltolization.

C. D. Barnes. U.S.P. 2,081,524, 25.5.37. Solvent extraction of petroleum fractions using an organic amide, *e.g.* acetamide, carbamide.

W. C. McBain. U.S.P. 2,081,632, 25.5.37. Apparatus for purifying used oil.

U. B. Bray. U.S.P. 2,081,731–2,081,732, 25.5.37. Propane deasphalting of hydrocarbon oils.

F. G. Fellows. U.S.P. 2,081,855, 25.5.37. Fractionation of crude to obtain increased yields of lubricating stocks by adding a topped crude containing a larger proportion of lubricating oil fractions than is contained in the crude to be distilled in order to raise the equilibrium flash vaporization temperature of the lubricating oil distillate. W. S. E. C.

Asphalt and Bitumen.

1075. Effect of Temperature on the Consistency of Asphalts. H. G. Nevitt and L. C. Krchma, *Ind. Eng. Chem. Anal.*, 1937, **9** (3), 119.—The authors discuss the various empirical susceptibility indexes that have been proposed and outline the requirements for a satisfactory index. They consider that the absolute measure of consistency is viscosity, and therefore susceptibility should be measured by the change in viscosity with temperature. The viscosity–temperature susceptibility coefficient is presented as a more fundamental viscosity–temperature index based on the A.S.T.M. formula.

$$S = \frac{0{\cdot}221 \operatorname{Log}\left(\frac{\log(\mu_1 + 0{\cdot}8)}{\log(\mu_2 + 0{\cdot}8)}\right)}{\operatorname{Log}\left(\frac{T_2}{T_1}\right)}$$

Where S is the susceptibility coefficient and μ_1 and μ_2 are the kinematic viscosities at absolute temperatures T_1 and T_2. Graphically S would be the slope of a straight line connecting the two points obtained by plotting the viscosities of an asphalt as obtained at two temperatures, on the A.S.T.M. chart D341–32T. Data are given that indicate that this index is applicable to a wide range of viscosities. The viscosities were determined in the Saybolt instrument using the three interchangeable (Universal, Furol and Road Oil) tips according to the hardness of the asphalt. In conclusion, it is stated that no correlation is suggested between the desirability of the product for specific uses and the susceptibility index, except where the change in viscosity with temperature is the prime factor. G. R. N.

1076. Physical Properties of Asphalt. S. Mason, R. J. Loomis, S. D. Patterson, H. G. Nevitt, and L. C. Krchma. *Ind. Eng. Chem. Anal.*, 1937, **9** (3), 138.—The viscosity–

temperature susceptibility index as developed by Nevitt and Krchma (cf. Abs. 1075) was determined for several U.S. domestic asphalts, a Mexican asphalt, pressure still tar and retort tar. The Mexican sample had the lowest index (0·707–0·736), whilst of the straight-run asphalts the Californian sample was the highest (0·836–0·855). The pressure still and retort tars had still higher indices, being over 1·0 in the latter instance. It is concluded from the data given that the viscosity–temperature susceptibility coefficient is readily applicable in the present stage of asphalt technology. G. R. N.

1077. Recovery of Bitumen. L. J. Chalk. *J.S.C.I.*, 1937, **56**, 156T–160T.—Details are given of a modification of Greutert's method for recovery of bitumen from bituminous mixtures and of a method for determining the amount of carbon bisulphide remaining in the recovered bitumen. Results of softening point, penetration, ductility, carbon, ash and colour determinations are given for a series of bitumens before and after recovery. The agreement is said to be satisfactory with exception of ductility, which is generally high. Physical and chemical characteristics of bitumens recovered from a number of rock and native asphalts are also given. The author found that the difference in colour of solutions of asphaltenes from different bitumens was much more pronounced than the differences between solutions of the bitumens themselves, and asphaltene colour determinations are recommended as an aid to identification of rock asphalts and Epuré. The properties of Trinidad Lake and Boetus Asphalts were found to be very similar. A. O.

1078. Bitumen Plastics. C. G. F. Pritchett. *Chem. and Ind.*, 1937, **56** (24), 543–544.—A brief account is given of the use of bitumen in the manufacture of moulded articles such as battery cases, switch-handles, telephone line insulators, etc. Plastics are usually prepared with Gilsonite, Rafaelite or Trinidad bitumen, but coal tar pitch of high softening point is also used, the bitumens are usually fluxed with soft petroleum residues. Both fibrous and non-fibrous fillers are used, the former consisting of asbestos or cotton linters and the latter of kieselguhr, slate powder or similar material. A. O.

1079. Petroleum Products in the Electrical Industry (II). C. Chilvers. *Petr. Times*, 29.5.37, **37**, 693.—The article deals with the use of petroleum oils in transformers and switches, and wax and asphaltic bitumen in general insulation. B.S.I. Specification No. 148 for insulation oils for electrical purposes (excluding cables) recognizes two classes of transformer oil A and B, according to their tendency to sludge in service, with sub-classes, *e.g.* A30 or B30 according to the cold test of the oil. Class A oils have the greater resistance to sludge formation. Tendency to sludge is estimated by the Michie test (I.P.T.), the Weiss and Solomon test (in France) and the Anderson (in Sweden). Since a large transformer may contain upwards of 10,000 gallons of oil, stability to service conditions is the main concern of their examination. Similar oils may be used in oil immersed switches when the breakdown voltage of the oil becomes of prime importance. Paraffin wax finds extensive use in the radio industry as an insulating and water-proofing medium in the assembly of small condensers, transformers, etc. In this connection the setting point, which should be high, *e.g.* 130° F., is the main criterion of quality. Asphaltic bitumen finds extensive application in all departments of the electrical industry. In the cable industry large quantities are used for insulating and weather-proofing and as an insulator in junction-boxes. A very large variety of grades are used, and both straight-run and blown products have their particular uses. Blown bitumens find numerous application in battery sealing compounds and as insulators where resistance to breakage by mechanical shock and tendency to flow are important. H. G.

1080. Failure of the Standard Method of Estimating Bituminous Content When Applied to Limestone. A. A. Ashworth. *J.I.P.T.*, 1937, **23**, 266–269.—Experiments are described which show that the standard method of cold extraction of limestone with carbon disulphide gave a bitumen content of 5% for the sample under examination, whereas hot extraction with trichlorethylene gave a bitumen content of 9·5%. G. R. N.

1081. Use of Bitumen Emulsions in Modern Road Construction. Anon. *Asphalt u. Teer*, 1937, **37** (16), 219.—This article deals with the use of emulsions in the construction of various types of road surfacing. A. O.

1082. Properties of Emulsifiers Used in Preparation of Bitumen Emulsions. R. Flavigny. *Bull. Assoc. Française T.P.*, 1937, **38**, 22–28.—The first part of this paper is devoted to consideration of the mechanism determining type of emulsion formed. It is thought that the liquid constituting the continuous phase of an emulsion is that in which the stabilizer is soluble or, in the case of insoluble stabilizers, that which wets the stabilizer. In the second part of the paper the rôle of the emulsifier in preparation of bitumen emulsion is discussed. It is stated that bitumens of different origin having similar physical properties may give emulsions which differ as regards particle size and stability when emulsified under identical conditions; similarly a given bitumen may give emulsion of differing particle size and stability when emulsified under differing conditions. A distinction is made between emulsifying power and stabilizing power of emulsifiers, and it is pointed out that although both properties may be present in an emulsifier, one or the other usually predominates. In order to form an emulsion, the interfacial tension between the bitumen at aqueous phases must be as low as possible and the dispersion must be protected as formed, and this depends on the nature and amount of active material present. The active substances are contained in varying proportions in bitumens, and bitumens containing sufficient material give stable emulsions with caustic alkalies, whilst bitumens deficient in active material require the use of emulsifiers, which, if the interfacial tension is high, must be completely soluble in the bitumen and dissolve asphaltenes and paraffins. Naphthenic acids of high molecular weight are stated to act as stabilizers and those of low molecular weight as emulsifiers. A. O.

1083. Mechanical Properties of Bituminous Surfacing Materials Under Constant Stress. A. R. Lee and A. H. D. Markwick. *J.S.C.I.*, 1937, **56**, 146T–156T.—This article describes investigations of the behaviour of bituminous surfacing materials under stress. It is stated that the study of the mechanical properties is intended to give information concerning the principles underlying the correct design of surfacing materials, and that such tests as are widely accepted are applicable to a limited range of materials and give results which cannot be regarded as definite physical constants. Bituminous materials are said to exhibit the characteristics of plastic, elastic and granular materials, and the relationship of these properties to road durability is discussed. The tension and shear tests used are described and the apparatus illustrated; results are expressed in the form of deformation–time curves. The factors requiring control in the preparation of specimens at the influence of the composition of the specimen on the mechanical properties are considered. Results obtained in the investigation are discussed. A. O.

1084. Experimental Road Work in Ayrshire. D. Torrance and R. B. S. Gilmour. *Roads and Road Constr.*, 1937, **15** (173), 134–137.—Details are given of various types of bituminous surfacing which the authors have tried out in Ayrshire, a number of the surfacings having been investigated in conjunction with the Ministry of Transport. Reference is made to penetration and premix methods of construction using emulsion, carpet coats, tar-rubber mixtures, coloured surfaces and soil-stabilization. A. O.

1085. Patents on Asphalt. U. B. Bray. U.S.P. 2,080,688, 18.5.37. Production of bituminous cement by cracking asphaltic crude.

D. E. Carr. U.S.P. 2,080,696, 18.5.37. D. R. Merrill. U.S.P. 2,081,496, 25.5.37. Production of petroleum plastics from petroleum pitches. W. S. E. C.

Special Products.

1086. Patents on Special Products. Carbide and Carbon Chemicals Corpn. and C. H. Walters. E.P. 465,848, 18.5.37. Production of maleic acid by catalytic oxidation of butylenes, butadiene or 1- or 2-butanol in the vapour phase.

G. W. Johnson. E.P. 466,210, 24.5.37. Production of olefines and hydrogen by oxidation of saturated hydrocarbon gas, *e.g.* ethane or propane.

Distillers Co., Ltd., H. Longwell and H. M. Stanley. E.P. 466,417, 24.5.37. Manufacture of ethylene oxide by oxidation of ethylene and removing the resultant gaseous products by the repeated use of activated charcoal.

Distillers Co., Ltd., H. M. Stanley and J. E. Youell. E.P. 466,439, 24.5.37. Hydration of olefines containing three or more carbon atoms to produce alcohols.

W. S. E. C.

Detonation and Engines.

1087. The Present Position and Prospects of the High-Speed Heavy Oil Engine. H. R. Ricardo. *Engineer*, 23.4.37, **163** (4241), 466.—The development of the airless injection engine is discussed in relation to combustion-chamber design. Various combustion-chamber shapes are reviewed and the manufacturing and running conditions necessary for satisfactory operation are given.

Among the total of about 6,000,000 B.H.P. of high-speed oil engines in service on the roads of Europe, it is stated that they are divided approximately equally between the direct injection type, the "Comet" type and the precombustion-chamber type.

The general improvement in detail is discussed and mention is made of the very high thermal efficiencies now obtainable; attention is directed to low-specific fuel consumption often being regarded as the most important factor; initial cost, weight, and reliability are stated to be equally important.

In conclusion, the author believes that there will be but small advances in regard to improvements in thermal efficiency, but that in the direction of speed and specific output, there is no limit to possible improvements. J. G. W.

1088. Development of the Two-Stroke Cycle Oil Engine No. 1. W. S. Burn. *Engineer*, 16.4.37, **163** (4240), 458.—The author recalls how the two-stroke cycle oil engine has been developed chiefly with a view to making more economic utilization of material than is found in the normal four-stroke cycle engine. To-day it may be said that not only does the two-stroke oil engine give twice or more the power from a given cylinder, but other advantages may be claimed from the point of view of improved performance and lower cost. It is observed that whereas the four-stroke cycle engine, at any rate in its single acting form, has kept remarkably standard in design, the two-stroke engine has been characterized by extraordinary variations in design, although to-day there are signs of a growing similarity.

The question of scavenging the cylinder is first considered. Typical scavenging systems of obsolete and current design are illustrated and their relative merits discussed. Broadly, there are two basic systems: the uniflow and the double-flow, but variations in these designs are made according to the size of the engine. With most systems the air charging is superior to that in the normal four-stroke engine. The development of scavenging systems has been assisted by research with glass cylinders in which the air-flow can be observed by threads, smoke streams, etc., and by Pitot Tube investigation. In the case of the opposed-piston engine, where sometimes a great number of additional running parts are entailed in the scavenging system, careful design of the engine in other respects has outweighed this objection, and there are a number of types of engine of the opposed variety which give excellent results. Particular attention to special points in the design of a well-known opposed-piston engine, and lately the adoption of welded steel for the entire main structure, have enabled low weights per B.H.P. of about 175 lb. to be obtained. In an attempt to obtain the advantages of the opposed-piston engine with a single piston, the author has devised a new system of port scavenging intended chiefly for high-speed medium-sized single-acting engines. Since the crossing of ports by piston rings is almost invariably necessitated through the location of the former, it is emphasized how important are the size and shape of the ports. The inside edges must be well rounded and radiused in an axial direction for good piston-ring operation. The author's experience is that neither exhaust nor scavenge ports have any appreciable effect on piston rings, provided the exhaust is reasonably clear, although he considers the exhaust valve-in-head two-stroke engine to have advantages in piston-ring operation,

especially under conditions of bad combustion. Modern style piston rings of small axial width and large radial depth are found to be the most suitable for two-stroke engines, and the diagonal or very short-lapped joint gives the most satisfactory results.

Various types of scavenging pumps are next described. These vary according to the design and size of engine. The simplest form is the crankcase scavenging. For small single-acting engines a single-acting piston driven from the connecting-rod has proved satisfactory. Generally the most satisfactory solution is to fit a separate low-pressure double-acting air pump driven directly from the engine. For relatively high-speed engines the author has recently developed a refined timed scavenge system with a cam or eccentrically-driven light-alloy oscillating flap. The last few years have seen the introduction of a number of rotary blowers invariably of the Roots type with two, three or four lobes. In some cases one blower per cylinder is fitted, but more usually two blowers are mounted at the back of the engine.

Turning now to a review of the numerous types of combustion chambers embodied in single-acting engines, the author considers the chief desiderata for efficient operation, and discusses the problems met with in various designs. Good relation between fuel distribution and air in the combustion chamber is required; a smaller excess air ratio is then necessary for a given power, and consequently less power is required for the air-charging process. The ideal combustion space should have the least heat transmission coefficient, which suggests the use of insulated surfaces as far as is practicable, and implies the desirability of as little air movement as possible which would facilitate heat transfer. The more perfect the combustion-chamber shape in relation to the injected fuel, the less is the air movement required to ensure intimacy between fuel and air, and one of the possible advantages of the single-acting two-stroke cycle port scavenging engine is the greater scope in combustion-chamber space design to suit the sprays. Numerous diagrams are given comparing various designs, including those from early air-injection engines, as well as those of current practice, and their relative merits are discussed. E. F. C.

1089. Diesel Engine Users' Association Bulletin 1936. Anon. D.E.U.A. publication No. 8138. A general review is given of the development of the diesel engine during 1936 and is divided under the following headings: Introduction, Design and Research, The Agricultural Position, Stationary Power Generation, Marine Propulsion, Rail Traction, Road Transport, The Aero Engine Position, Diesel Fuels, and Diesel Lubricants. J. G. W.

1090. Spark-Plug Adapted for Measuring Cylinder Head Temperatures. G. D. Boerlage and A. G. Cattanes. *J.S.A.E.*, 1937, **40**, 151–152 and 172.—The difficulties encountered in obtaining thermocouple measurements at the cylinder walls of water-cooled engines have led the authors to temperature measurements via the spark plug. The usual types of such couples, however, viz. the gasket type and the central electrode type, are not particularly satisfactory. The gasket type, by reason of the fact that it is not situated very near the cylinder wall, responds more nearly to the cooling medium fluctuations than to cylinder wall temperatures, and gives a distorted and reduced scale record. The central electrode type has the opposite effect, and responds to mean gas temperatures and tends to exaggerate the importance of momentary high gas temperatures. The special couple mainly referred to in this article is constructed with its wires running down through the metal of the plug body, with the actual couple on the front face of the plug. It is claimed that this couple gives temperatures practically equal to cylinder wall temperatures, and is not affected by varying wind speed on an air-cooled engine to anything like the extent of the gasket type. The temperature-measuring circuit is completely insulated from high-tension current. C. H. S.

1091. Hydrocarbon Reactions and Knock in the Internal-Combustion Engine. G. von Elbe and B. Lewis. *Ind. & Eng. Chem.*, 1937, **29** (5), 551.—A brief summary is given of the chain mechanism of the oxidation of hydrocarbons.

The combustion process of the Otto cycle engine is pictured to involve a race between combustion by a moving flame and the spontaneous ignition of the part of

charge ahead of the flame. The latter occurs only after some time has elapsed following the establishment of ignition conditions in the unburnt charge.

In normal combustion the flame travel is completed before the ignition lag is terminated, whereas in knocking combustion the reverse is true.

The various factors that determine the rate of flame travel and ignition lag are discussed, and numerous experimental facts both chemical and physical are interpreted, including the action of anti-knock agents. J. G. W.

1092. Flame Travel in Internal-Combustion Engines. S. S. Watts and B. J. Lloyd-Evans. *Engineering*, 1937, **143** (3728), 713.—Some measurements of flame velocity in a spark ignition engine are described, the method used being a modification of the ionization method developed by Schnauffer. By means of a contact breaker, driven from the crankshaft at half speed, it was possible to determine the angular position of the onset of ionization at electrodes located in the cylinder head and piston.

The tests were made on a four-stroke gas engine of 4¼-inch bore and 6-inch stroke at speeds of 496 and 585 R.P.M.

The flame speed was found to be greatest when the mixture strength was about 18% rich, and increased slightly with increase in load. Increased running speed and advanced ignition timing were both found to increase the flame speed for the range of conditions studied. J. G. W.

1093. Combustion in Engines. W. Ostwald. *Petr. Zeit.*, 9.6.37, **33** (23), 1.—This is a reprint of Brochure No. 6 of the Austrian Petroleum Institute. It discusses a subject which has received only sporadic attention in the literature. Curves of Carnot's cycles for maximum heat economy of motor fuels are given, and Otto and Diesel combustion is described. Four fundamental influences on combustion are discussed, viz.: (1) substance (fuel and air); (2) course of chemical action; (3) form and walls of the combustion chamber; and (4) effect of time on volume change. Several examples are given and diagrams of combustion in homogeneous mixtures and non-homogeneous substances, *e.g.* fuel injection. W. S. E. C.

Economics and Statistics.

1094. Discovery Rates in Oil-Finding. W. E. Pratt. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 697–705.—This paper is a general statistical inquiry into the U.S.A. oilfield discoveries by successive five-year periods since 1901, and the progressive accumulation of the reserves of oil; the discoveries are classified according to the method by which they were made.

The most striking feature of the progress of discovery is shown by the fact that 2165 million brls.—or nearly 40% of all the oil—was obtained within the period 1926–30, half the grand total being found within ten years, 1921–30. Of the three most important producing States (California, Oklahoma, Texas), a general accelerated rate of discovery is shown from 1901 until in each case the peak period (1926–30) was reached. This was more than double the current rate of consumption. Thereafter, however, an abrupt decline set in.

A similar result is arrived at in reviewing the figures for oilfield discoveries. A gradual rise occurred through successive five-year periods, reaching a conspicuous peak (59 in number or 30·4%) during the period 1926–30 and subsequently dropping abruptly.

The conclusion is reached that if the established record in rate of discovery is to be maintained, or even to find oil sufficient for the current rate of consumption, further improvements in finding technique are essential. Persistence in the exploration for deeper oil in areas already proved has resulted in relying very largely on geophysics as a guide to finding. This method alone has not proved equal to the task.

A promising means for the improvement in oil finding has been suggested by A. I. Levorsen, who recommends that an intensive search should be made for "stratigraphic traps." The new technique would involve intensive studies in stratigraphy, sedimentary petrography and palæontology, combined with the continued assistance of geophysics.

If adopted, this technique is expected to result in an increase in the ratio of dry holes to discoveries and to hasten the demand for expert geological supervision.

G. S. S.

1095. Future of Petroleum Exploration in United States. E. De Golyer. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 706–714.—This is a general survey and discussion in relation to the prospecting problem of the petroleum industry. Following a brief review of the history and growth of the industry from 1859, exploration activities of the future are examined.

These should include surface and subsurface studies, stratigraphy and palæontology, geophysics, engineering and land leasing, and organization for the drilling of exploratory wells.

Definite advantages which should accrue from such a course are: the development of special equipment and practice drilling of exploratory or wildcat wells, development of cost accounting and critical analyses of statistics of the industry as a whole.

G. S. S.

1096. Petroleum Industry in the U.S.S.R. Final Programme for 1937. I. Ganitzki. *Mon. Petr. Roum.*, 1937, **38**, 721–723.—The final programme fixed for 1937, as in previous years, shows a considerable reduction on the 1933 forecast for the period 1933–37 inclusive. Actually in 1937, 34·5 million metric tons will be attempted instead of 46·8. The 1936 final programme was realized to the extent of 97%, but whether the 1937 one will be depends on the credits available and technical methods.

Credits. The original plan for 1933–37 visualized a total production of 179 million tonnes of crude oil and gas at a total cost of 4700 million roubles. At most only 138 million tonnes will be produced, and to complete the 1937 final quota an additional credit of 300 to 400 million roubles will be required.

Technology. 2·8 million metres will be drilled in 1937 against 2·1 million in 1936, the increase being due to quicker work, thanks to the Stakhanov system, to the use of hard alloys in the drills, and to a realization of the fact that a well of great depth needs a drill specially designed to work at that depth.

In 1936, 1600 new wells, out of a programme of 1666, came into production. In 1937 it is proposed to open up 3600 new wells, including in this number 1500 already opened and abandoned.

Fourteen new rich fields were opened in 1936, and fourteen more have been or will be opened in 1937. About twenty will be prepared for production in 1938. Russian reserves are considered to be probably the greatest in the world.

Organization. New trusts are being formed and the big "Grozneft" trust has been decentralized. Separate departments, more or less independent, control its refineries, its plans and buildings, its prospecting and exploring, and its finance. There are three separate producing units.

Given the necessary credits, elasticity in production, and payment of all workers by results, the 1937 plans of production will be realized.

Refining. The capacity of refineries, etc., at the end of 1936 was 28 million tonnes a year and may be raised to 32 in 1937. About 2·7 million tonnes of "straight" petrol will be produced, and possibly 2·9 million tonnes by cracking. Other forecasted figures are, 6·4 million tonnes of paraffin and light oils, and 2 million tonnes of lubricating oils.

W. E. J. B.

1097. Natural Gas Industry of the U.S.S.R. I. Ganitzki. *Mon. Petr. Roum.*, 1937, **38**, 803–806.—A brief survey of the natural gas industry before the nationalization is followed by the development since that period. A table illustrates the production of gas rising from about 23,000 tonnes in 1921–22 to 1,646,000 tonnes in 1935. Even up to 1928 the gas was very badly utilized; of the 270,000 tonnes produced 173,400 tonnes were burned before stripping, but around this time more attention was devoted to the subject, stripping plants were installed, and in 1931 it was officially recognized that natural gas was an important branch of the industry, and it was planned accordingly.

In 1932 the industry received 6,180,000 roubles, the bulk of this being shared fairly equally among Maineft, Grozneft and Azneft. The programme for Maineft illustrates the general tendency in the planning of gas utilization. In 1933 the 700,000 tonnes

production was allocated as follows: gasoline 70,000; carbon black 300,000; repressuring of wells 120,000; fuel 210,000, with no mention of the chemical industry. In 1937, a 1,350,000 tonnes production was allocated thus: gasoline 135,000, carbon black 360,000, repressuring of wells 430,000, fuel 125,000 and chemical industry 300,000 tonnes. In the 1933–37 period sixteen factories costing 12,000,000 roubles were planned for a total annual production of 16,000 tonnes of carbon black, but by the end of 1937 the total capacity of the factories will be about 27,000 tonnes. This carbon black is absorbed mainly by the rubber industry.

A table estimates the gas reserves, totalling 985,860,000,000 cubic metres, and shows that by far the greatest proportion of this is obtained from oil wells rather than simple gas wells. Losses are still heavy—for instance, the Kala field loses 1,000,000 cubic metres per day from gas lifting.

The article concludes with a general survey of the increasing demand for natural gas, though there is a lack of information of its use for synthetic hydrocarbons.

T. C. G. T.

1098. Roumanian Petroleum Products in Palestine. A. Botez. *Mon. Petr. Roum.*, 1937, **38**, 795–796.—Palestine has a population of 1,269,000, about 15,000 automobiles and 1222 kms. of good roads. From the aviation point of view there are, in addition to the Air Force, three airports and five air lines operating weekly services. A brief survey of the essential details of her financial position, such as the budget and import and export values, is given.

Palestine imports over 150,000 tonnes of petroleum products per year, and thus offers an important and growing market for Roumanian petroleum. Tourist traffic is stressed as a big consumer of motor fuel, and there is a large consumption of lamp oil. Tables illustrate the total imports and the percentage of each product supplied by Roumania. About 70% of the petroleum is imported from Roumania, and in 1936, 40·6% of this was motor spirit and 43·6% lamp oil.

The Customs duties on the various products are listed. That on motor spirit is 11 mils. per litre, lamp oil 31·8 mils. per 18·2 litres, lubricating oil 3 to 5 mils. per kgm., whilst gas and diesel oils are exempt.

The companies operating in Palestine are listed.

The author directs much attention to the Irak Petroleum Co.'s pipe-line, quotes a few general details and warns the Roumanian industry of the probable effect on its Palestine market of the proposed refinery at Haifa. The discovery of petroleum deposits in Northern Syria and the probability of this concession being granted to the Irak Petroleum Co. are of great importance to Palestine. T. C. G. T.

1099. Effect of the New Roumanian Mining Laws. L. Wenger. *Mon. Petr. Roum.*, 1937, **38**, 877–878.—The article is devoted to the effect of the new law upon the petroleum industry. As 30% of the national revenue is derived from this industry, the precarious state of its production is necessarily of great moment to Roumania. The pressing need is intensive exploration, but the great financial risks of this aspect of the industry are stressed—in 1936, of eighteen wells drilled only six found oil, and of these five were in the same region. It is therefore made clear that it is an unwise policy which limits the activities of private enterprise, either by not conceding sufficient territory for prospecting and exploitation, or by reducing potential remuneration by high dues. T. C. G. T.

BOOK REVIEWS AND BOOKS RECEIVED.

Book Reviews.

WATER-WHITE HYDROCARBONS FROM TRINIDAD ASPHALT. Halley Tansley Gaetz. 137 pp. Illus. 6. Grafton Publishing Corp. of Los Angeles, California, U.S.A., 126 West Third Street.

This publication consists of a volume of 137 pages and 6 illustrations, together with a supplementary brochure of some 60 pages describing some extensive experimental work carried out in the Laboratory of the University of British Columbia, Vancouver.

The main volume is divided into three reports, the first of which describes some rather involved experimental work investigating selective solvent action of petroleum ether upon asphalts, and also the division of bitumen into three major portions by vacuum distillation. The cut-oils of both low and high boiling point were individually acid refined to such purity and stability as to remain water-white for a period of over two hours. This report is headed "A simple process of preparation," but the presentation would appear to be anything but simple.

After extensive references to published scientific literature and some rather unexpected quotations from other literature, Mr. Gaetz passes to the second report headed "Fractional Distillation for Property Study." This section describes in considerable detail some fractional distillation work on bitumens, and is followed up in the third report, in which some extensive tables are given of the physical properties of numerous fractions obtained during the distillation experiments. Here again the work is very extensive and somewhat involved, and the report includes some rather complicated discussion on matters such as refractive index and molecular weight.

After the three reports there follows a discussion on the research, which appears to be a rather unusual presentation of comments by certain reviewers on Mr. Gaetz's work, together with the author's reply to the reviewers' criticisms.

The situation is still further complicated in the supplementary brochure, which is entirely devoted to still further discussions on the earlier work. Portions of this are very difficult to follow, particularly in view of sentences, such as that on page 159, where one sentence occupies twenty-five lines.

Considering Mr. Gaetz's work as a whole, it would appear to be a record of some interesting experiments in the application of well-known distillation and similar principles to Trinidad asphalt, but the reviewer regrets that there would appear to be little of real value to the serious student of asphalt technology or to the asphalt industry.

D. C. B.

THE REACTIONS OF PURE HYDROCARBONS. Gustav Egloff. The Reinhold Publishing Corp., New York, 1937. Chapman & Hall, Ltd., London. 897 pp. 4 *gns.*

It is with very considerable pleasure that we welcome the appearance of an outstandingly important work by our United States colleague and fellow member, Dr. Egloff. Many of the members of the Institution have had the privilege of meeting him, and it will be within their memory that quite recently he addressed large meetings both in London and at the branches in Manchester, South Wales and Roumania.

This monumental compilation is very worthy of its eminent author, who, with his associates, has worked for more than ten years on its preparation. Egloff says: "It has been the purpose of the author to bring together in this volume the reactions of pure hydrocarbons which occur as the result of thermal, catalytic, photochemical or electrical treatment." It can be said without doubt that, wide as is the scope of the work, this object has been most completely realized.

Some idea of the painstaking effort to assemble in the compass of a single volume a vast amount of research by over 1200 investigators published the world over, may be seen in the fact that the bibliography contains over 1500 references and the very complete indexes occupy 55 double-column pages.

Primarily, of course, the work has a bias towards petroleum chemistry, but, on the other hand, there is a mass of knowledge available for the research worker in every field in which hydrocarbon chemistry plays a part.

The book contains seven chapters. Chapter I deals generally and broadly with petroleum hydrocarbons; it is introductory, and stresses the almost astronomical quantities of liquid and gaseous derivatives available. Chapter II is concerned with the reactions of paraffin hydrocarbons, and over 200 pages are occupied with an exceedingly full description of the normal paraffin hydrocarbons and their homologues, from methane to hexatriacontane. In every case non-catalytic, catalytic and electric treatments are discussed. As an example, the action of cathode rays on many hydrocarbons, in so far as they have been examined, is described. Chapter III deals in a correspondingly thorough way with the olefine hydrocarbons; Chapter IV with the acetylene group; Chapter V with the aromatic hydrocarbons; Chapter VI with *cyclo*-paraffins and *cyclo*-olefines, and Chapter VII with the terpenes. At the end of each chapter is a complete bibliography, which will be found extremely valuable to chemists working in these particular fields.

The book makes a specially appropriate appearance, in that striking advances are being made to-day in every direction of hydrocarbon work, and it will make an appeal to researchers not only in petroleum, but also in general scientific work in the fields of plastics, gas, rubber and derived organic compounds.

There is not the slightest doubt but that Dr. Egloff has manufactured in this compilation a most valuable tool for the laboratory and the study. A. E. D.

Books Received.

U.S. Geological Survey:

BULL. 874-B. GEOLOGY AND FUEL RESOURCES OF THE SOUTHERN PART OF THE OKLAHOMA COAL FIELD. PART 2. THE LEHIGH DISTRICT, COAL, ATOKA, AND PITTSBURG COUNTIES. M. M. Knechtel. iv + 149 pp. Illus. 1937, Superintendent of Documents, Washington, D.C. 20 cents.

This report describes an investigation of the geology, coal resources and oil and gas possibilities of the Lehigh district. Wells have been drilled for oil and gas in several parts of the district, and gas has been struck, but not marketed, in the Ashland, Coalgate and Centrahoma anticlines. Nearly all the wells penetrate only the Atoka and younger formations, reaching depths ranging from 1300 to 3380 ft. Most of the gas that has been found issues from the Hartshorne sandstone. No oil has been discovered to date, but the pre-Pennsylvanian rocks underlying the area have not been adequately tested by the drill. A geological map of the district is attached.

BULL. 876. COAL DEPOSITS OF THE PIKE COUNTY, KENTUCKY. C. B. Hunt, O. H. Briggs, Jr., A. C. Munyan and G. R. Wesley. v + 92 pp. Illus. 1937, Superintendent of Documents, Washington, D.C. $2.25.

This report describes the results of the investigation undertaken to obtain data on the extent, thickness, character and other features of the coal beds of the Pike County as would be of value in the proper development of future mining operations. The report is accompanied by forty-eight plates showing sections, correlations and altitudes of coal beds in the various divisions of Pike County.

BULL. 882. SPIRIT LEVELLING IN MASSACHUSETTS. 1922–35. J. G. Staack. Pp. ii + 156. Illus. 1937, Superintendent of Documents, Washington, D.C. 15 cents.

The results are recorded of a level control survey of Massachusetts, carried out by the U.S. Geological Survey.

Commonwealth of Australia:

REPORT TO THE COUNCIL OF THE LEAGUE OF NATIONS ON THE ADMINISTRATION OF THE TERRITORY OF NEW GUINEA FROM 1ST JULY, 1935, TO 30TH JUNE, 1936. L. F. Johnston. 130 pp. 1937, Commonwealth Government Printer, Canberra.

This report contains an account of the general and legal administration, education, public health, lands, surveys, mines and forests of New Guinea for the year under

review. A map is attached showing areas under various degrees of Government control.

Geological Survey of Uganda :

MEM. No. III. 1936. THE VOLCANIC AREA OF BUFUMBIRA, PART II : THE PETROLOGY OF THE VOLCANIC FIELD OF BUFUMBIRA, SOUTH-WEST UGANDA. A. Holmes and H. F. Harwood. xiv + 300 pp. Illus. 1937, Geological Survey, P.O. Box 9, Entebbe, Uganda. 21*s*.

Results are given of chemical analyses of selected rocks and a detailed and comparative petrological study of the Bufumbira province. The conventional concepts of petrogenesis are superseded by a theory of transfusion by "flux of emanations," which is analysed and discussed. A bibliography and index are included.

TRANSACTIONS OF THE INSTITUTION OF CHEMICAL ENGINEERS. VOL. 14, 1936. 176 pp. Illus. Institution of Chemical Engineers, 56 Victoria Street, S.W. 1.

Included in the papers published in this volume are reports on "Colloidal Fuel," by A. B. Manning and R. A. Acton Taylor; "The Design of Vessels to Withstand High Internal Pressures," by D. M. Newitt; "A Nomographic Chart for the Computation of Fractionating Columns for Binary Mixtures," by R. Edgeworth Johnstone; "Entrainment in a Bubble-Cap Distillation Column," by A. K. G. Thomson, and "Corrosion," by R. F. Hayman.

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Zemmer, J. C., 1148

Geology.

1100. Origin of Glen Rose Formation is Interesting Geologic Study. H. D. Easton. *Oil & Gas J.*, 8.7.37, **36** (8), 20.—A study of the Glen Rose Series leads to the conclusion that they originated from coral growth in irregular tidal basins. Wave action broke down the corals and calcium carbonate deposited on the fragments cemented them into a porous limestone series. Slow subsidence of the sea resulted in the corals being killed and the deposition of mud which later formed shale beds. Subsequent movement cut off the basins from the main sea, and desiccation resulted in

the deposition of gypsum and probably rock-salt. Loss of water converted the former into anhydrite and the salt was probably removed by solution.

The irregularity of the porous layers which form the oil traps are thus explained and point to the advisability of testing the whole of the Glen Rose Series below the anhydrite before abandoning a well. J. A. G.

1101. Physical Characteristics of the Bradford Third Sand and Relation to Occurrence of Oil. C. R. Fettke. *Oil & Gas J.*, 5.8.37, **36** (12), 20–22, 24–25, 35.—The Bradford Third Horizon was deposited over a much larger area than that occupied by the oil-pool, but it is in the latter area that the sand-bodies are thickest and the shale partings less numerous. The field is developed on two asymmetrical anticlines trending N.E.–S.W., which converge to form a broad dome in the N.E. To the N., N.E., and S.E. of the dome the shale bands increase in thickness and the sand development is poor, but to the S.W. the sand-bodies maintain a total thickness of from 25 to 65 ft. and eventually split into two lobes.

The sand is chocolate-brown in colour and composed of fine-grained, angular quartz. Small amounts of muscovite, chlorite, secondary silica, calcite, and a limonitic clay also occur. Where the sand has a lower porosity than the average it is probably due to the presence of these latter minerals, which tend to fill the pore-space between the quartz grains. The upper part of the sand bed normally has a greater porosity than the lower; also many "loose streaks" occur which may have porosities of 20% or more.

It is concluded that the Bradford Third Horizon was deposited in a shallow Upper Devonian sea which was bordered on the east by a low-lying land mass. The streams from this area brought down large quantities of sand and silt which were subsequently sorted and distributed by the sea. Although structure is now apparent in the field, it is pointed out that much of the oil probably entered the sand before the close of Mississippian times, when the present features did not exist. It is probable, therefore, that accumulation was originally governed by the extent of the sandy portion of the horizon. J. A. G.

1102. Geological Structures Mapped in Apache County, Arizona. H. Roe. *Oil & Gas J.*, 22.7.37, **36** (10), 29–30.—About seven or eight domes have been discovered in the Apache–Navajo geosyncline, the axis of which runs N.W.–S.E. between the White Mountain Uplift on the S.W. and the Zuni mountains and Fort Defiance Uplifts on the E. and N.E.

Several wells have been drilled in this area and have found the Permian resting on Pre-Cambrian in the crests of the structures, but there is a thick Pennsylvanian series a short distance down the flanks. The Apache Dome, which is typical of these structures, has an area of 4000 acres with dips of from 4° to 10°, and closure from 75 to 175 ft. The succession is given as follows: 1850 ft. of Triassic and Permian sands and shales followed by 1100 ft. of Pennsylvanian limestones, sands and shales. These are underlain by more limestones, sands, shales and conglomerates of Mississippian, Devonian and Ordovician age. It is estimated that about 1000 ft. of fossiliferous beds are present in this section and it is hoped that several of the structures will prove productive. J. A. G.

1103. Oriskany Sand of West Virginia. J. E. Billingsley. *Oil Weekly*, 26.7.37, **86** (7), 14–20.—The Oriskany sand is the top member of the lower Devonian series, lying between the West Virginia Corniferous limestone and the Helderberg limestone group. This article is the first of two describing the sand, and refers to the geological aspects of the subject. A well drilled near Charleston in 1930 produced a considerable quantity of gas, and numerous other wells which have been drilled have met with varying success; a little oil production was obtained in 1932.

The structure of the surface beds and down to the base of the Mississippian is well known and is not complicated. The major fold in Kanawha county is the Warfield anticline running and plunging to the N.E. from a faulted zone on the Kentucky state line. A number of similar trends are also known and are described. Accumulation is controlled by the structure in combination with the porosity. The thickness of the sand (30–35 ft. in the Elk–Poca field), the almost complete absence of oil and

salt water, and the uniform gentle folding promises longer life than was shown by earlier fields, especially those in Ohio. Since 1934, 84 wells have been completed in the sand with a combined initial open flow of 407 million cu. ft., and the reserve is estimated at 200,000 million cu. ft. The wells have an average depth of 4800–5000 ft., and the drilling costs are briefly mentioned. The acreage and ownership is referred to, and after describing the possible value of geophysics in the area, the article concludes with some remarks on the gasoline content of the gas, which has run as high as 700 gallons per million cu. ft. A. J. H.

1104. Permian Basin Crude Reserves Increasing. H. H. King. *Oil Weekly*, 19.7.37, **86** (6), 38, 40, 42.—The Permian Basin is credited with a production of almost 900 million brls. up to the end of 1936, and with an estimated crude reserve of over 1790 million brls. Permian production from West Texas and New Mexico comes from closely related trends, and new discoveries and developments may be safely forecasted. The reserves of the major fields of the basin are referred to, that of Yates being by far the largest. Production from the Ordovician at Big Lake and on the Sand Hills structure directs attention to the possibilities of formations of that age. In Lea county, New Mexico, the bulk of the reserves are located on a dolomite trend running N.W., Hobbs being the largest of the fields. A. J. H.

1105. Major Field Indicated in Turner Valley, Alberta. R. C. Rowe. *World Petr.*, June 1937, **8** (6), 80, 89.—The field is located on a N.–S. anticline the eastern flank of which is cut by a fault, displacing the productive Carboniferous Limestone. The western flank is now being explored and several wells have obtained good production of crude oil. As a result of these tests it is now thought that as the gas pressure on the crest of the structure is reduced, water is driving the oil up dip. If this is the case, Turner Valley may prove to be of greater value than at first thought, and the whole foothill region will be explored with a view to discovering the Carboniferous Limestone in similar structures. J. A. G.

1106. Progress in Alberta Crude Oil Search. E. H. Cunningham Craig. *Petr. Times*, 14.8.37, **38** (970), 202.—Progress is reported in the exploitation of the N.W. flank of the Turner Valley structure, where there are good prospects of prolific production. A well drilled near the central part of the valley on the W. flank was a failure, but does not preclude all possibilities of production there. Acid treatment of the producing horizon appears to have met with success. Reference is also made to wild-cats away from Turner Valley. A. J. H.

1107. Waters, Rocks and Minerals of the Tupungato Country. M. C. de Chaudet. *Bol. Inform. Petroleras* (*B.A.*), April 1937, **14** (152), 21–37.—Exploration began in this region in 1934, since when 17 wells have been drilled along the Cieneguilla anticline, the locations being indicated on a map which accompanies the article. Production was expected from the formation which is productive at Cacheuta, further to the N. Oil was found in much younger beds, however, and mammalian remains dated them as upper Tertiary. All the wells met brackish water at varying depths, and at temperatures exceeding the normal geothermal gradient. Analyses of the waters are presented in tabular and graphical form, all being very similar, with the exception of some fresh water found in one of the wells at a depth of 412 m. They are characterized by high calcium and sodium chloride contents, with no more than slight traces of magnesium, sulphates or bicarbonates. Several microphotographs of crystalline residues are reproduced.

A log is supplied of the deepest well yet drilled, which has penetrated various sandstones, conglomerates and variegated shales. The sandstones, which are discussed in some detail, vary somewhat in mineralogical constitution, and widely in texture. Some of them contain much fresh plagioclase, and up to 10% of heavy minerals. Many of the cores show fissures and fracture planes, and the article concludes with an account of a zeolitic mineralization of many of these fissures. A. J. H.

1108. Stratigraphy of the Rocks Outcropping in the Luján de Cuyo, Potrerillos and Tupungato Area. E. Truempy and R. Lhez. *Bol. Inform. Petroleras* (*B.A.*), April 1937, **14** (152), 39–56.—This area has long been studied by geologists, on account of oil shows on the S. flank of the Cacheuta uplift. A knowledge of the stratigraphy is essential, because of the complicated tectonics.

The oldest outcropping rocks are Palæozoic in age and consist mainly of greenish argillaceous slates, with some quartzites, grauwackes and igneous intrusions. Porphyritic breccias and conglomerates occur on the S. and S.E. of the Cacheuta uplift, while in Potrerillos there is a thick series of hæmatitic porphyritic conglomerates known as the Paganzo series. The Rhætic beds which lie unconformably above the Palæozoic are of a lagunary facies and contain leaf impressions and ganoid scales. They are subdivided into the Potrerillos beds below and the Cacheuta beds above, there being no discordancy. The Cacheuta beds contain some slightly bituminous shales. The overlying Cretaceous beds are of a continental facies and are subdivided into six zones, all of which are described. There are over 3000 m. of Tertiaries which are also of a continental type, consisting essentially of shales, sandstones and conglomerates. The various subdivisions are described, these being as follows, reading upwards in the succession: Cross-bedded zone, Mariño beds, Lower sandstones, Cara de Puerco series, Ceniza Blanca horizon, La Pilona series, Upper sandstones, Yellow series, and the Mogotes conglomerates. The Upper sandstone series is differentiated from the Lower by its greater content of volcanic material.

A stratigraphical table and several sections accompany the article. A. J. H.

1109. Attock Oil Progress at Dhulian. Anon. *Petr. Times*, 14.8.37, **38** (970), 209–210.—A brief survey of future possibilities following the discovery of oil in appreciable quantities on the Dhulian dome, N.W. India, which covers a considerable area.
A. J. H.

1110. Prospecting in Abyssinia. Anon. *Petr. Z.*, 9.6.37, **33** (23), 13–14.—Extensive oil shows are found in the Danakil desert. These occur in a zone 800 m. wide and several kilometres long, the oil being of good quality and often under considerable pressure.

There is some conflict of opinion as to the possibilities of the coastal areas of Eritrea. A boring, some 200 m. deep, on the island of Dahlak which lies close to Massaua gave indications of gas and petroliferous strata. Italian geologists and geophysicists have been working there for 12 months. The geological formations, however, are not such as to give rise to any considerable optimism.

In addition to petroleum, attention is being paid to the production of fuel alcohol and of compounds of the benzene type which are obtained from the milky juice exuded by a species of Euphorbia. S. E. C.

1111. Zistersdorf Oilfield. K. Friedl. *Bohrtech. Z.*, March 1937, **55** (3), 53–56.—The geology and producing horizons of the Zistersdorf field are described, with particular reference to the well "Gösting VII." The success of this and of other wells points to the great importance of the Up. Tertiary, and especially the Sarmatian, as a productive formation in the Vienna basin. Other prospective structures are mentioned.
S. E. C.

1112. New Oilfield at Sokolnice, Czechoslovakia. E. Schnabel. *Petr. Z.*, 1.7.37, **33** (26), 9–11.—This article deals mainly with the history of the negotiations leading to the development of the field. A number of references to other articles on the area are given. Numerous shallow borings have been made and the possibility of opening a mine near Brünn has been seriously considered. S. E. C.

1113. Soviet Oilfield Rapidly Expanding. Anon. *Oil News*, 29.7.37, **42** (1287), 60.—This short article refers to new fields and developments at Krasnokamsk, Syzran and Tuimas, and concludes that oil occurs in the entire Carboniferous stratum between the Volga and the Urals. A. J. H.

Drilling.

1114. A Review of Progress and Trends in Drilling Practice. K. C. Sclater. *Petr. Eng.*, Midyear 1937, **8** (10), 20.—Drilling activity has proceeded at a brisk pace during the past year. Drilling methods have received more attention than in the past and the trend towards portable drilling equipment for increasingly deeper drilling is evident. Refinements have been made on the unitization of deep drilling equipment and higher mechanical efficiency in deep drilling operations is being sought. Improvements have been made in casing and cementing operations and in methods of well completion. L. V. W. C.

1115. Progress and Trends in Pressure-Control Drilling and in the Application of Bottom-Hole Chokes. H. C. Otis. *Petr. Eng.*, Midyear 1937, **8** (10), 32.—Drilling-in under pressure control is now almost standard practice in certain fields. The equipment used for this type of drilling-in has undergone continuous improvement during the year. Drilling-in under pressure has necessitated the running and pulling of a great deal of drill stem and tubing under pressure and this has been accomplished successfully against closed well pressures as high as 2550 lb. per. sq. in.

Bottom-hole chokes are now employed to reduce emulsification and to lower gas/oil ratios as well as to eliminate freezing.

Blank removable chokes, or casing plugs, have been employed to excellent advantage in plugging casing when it becomes necessary to change surface connections.

L. V. W. C.

1116. Drilling and Completing World's Deepest Producing Well. D. S. Sneigr. *Petr. Eng.*, July 1937, **8** (11), 38.—After 8 months' careful work during which all the latest engineering practices were brought into play the world's deepest producing well has been completed. Several new records were established, among which were the successful landing of the longest string of 9⅝-in. casing ever run, the setting of the longest string of casing of any size ever run in a well, and the gun perforating of casing at a depth of over 12,000 ft. Shooting was carried out at about 12,018 ft. The temperature reached was 180° F. and this permitted the placing of cement successfully without resort to the use of ice for cooling. L. V. W. C.

1117. Drilling Problems in the Illinois Basin. R. N. McIlvain, Jr. *Oil Weekly*, 5.7.37, **86** (4), 22.—The problems dealt with were encountered in the deepest part of the Illinois Basin. Little gas is available and the most practical power when drilling with cable tools appears to be gasoline engines or Diesel engines. Sufficient water is available from shallow wells or nearby streams.

Up to a depth of 1500 ft. the hole will stand up well but below this depth the cavey shales present a problem. These shales cave readily in a dry hole and rapidly in a wet hole. It is necessary, therefore, to commence with a large diameter if the hole is to be carried to any appreciable depth and end up with a good-sized hole. It may be necessary to "carry" casing. If this operation is carried out, considerable underreaming is required. Underdrill bits are used extensively in the S.W. portion of the Basin.

Difficulties arise when rotary drilling is tried owing to fuel and water problems. The most practical equipment to use would appear to be a Diesel, or a steam economy rig, or a combination of both. To obtain sufficient water for drilling during the dry season the safest practice would be to lay a line to a reliable source of water as shallow wells would not supply enough.

Completion problems are of vital importance and it is thought that completing wells by cable tools will be most economical. L. V. W. C.

1118. Four-Engine Diesel Rig Proves Economical. D. S. Sneigr. *Oil Weekly*, 12.7.37, **86** (5), 44.—A four-engine Diesel rig has recently made its appearance in the Gulf Coast.

Two V-8 engines are connected through a gear-box to the draw works, being so arranged that either one or both engines may be used. For drilling only one engine is in operation, but for pulling drill pipe both engines are employed.

Two six-cylinder motors are compounded to operate a large 7¼-in. × 18-in. mud pump.

To complete the motive power on this rig two small gasoline engines are installed for driving a light plant generator and an air-compressor. L. V. W. C.

1119. Improved Mud-Circulating Systems Cut Drilling Time. B. Mills. *Oil Weekly*, 12.7.37, **86** (5), 40.—An increased volume of mud with a reduced pressure has been obtained by the use of full hole tool joints, larger openings in the surface mud equipment, elimination of unnecessary turns in the mud lines, large capacity slush pumps, large inside diameter drilling hose and larger holes in the bit.

Each of these items is considered fully. L. V. W. C.

1120. Experimental Tests on Neat Cement. S. L. Meyer. *Petr. Eng*, July 1937, **8** (11), 50.—A series of tests was carried out on neat cement to give the engineer some insight into what may be expected from hardened neat grout when different forces are applied to it. Many of these tests are rarely made.

A table showing the physical properties of neat oil-well cement together with the chemical analysis of the cement used is given. L. V. W. C.

Production.

1121. A Review of Progress and Trends in Production Practice. K. C. Sclater. *Petr. Eng.*, Midyear 1937, **8** (10), 106.—Among the problems receiving attention in the production field are those involving sub-surface conditions in the reservoir as they apply to the economical production of oil and gas. These cover sub-surface pressure measurements and equipment, sub-surface sampling of oil and its examination; energy characteristics of the reservoir contents; the determination of connate-water content of oil sands; and improving the technique involved in examining cores.

Each of these items is examined in detail. L. V. W. C.

1122. Review of Progress and Trends in Acid-Treating Oil and Gas Wells. H. F. Wright. *Petr. Eng.*, Midyear 1937, **8** (10), 124.—Acid treatment of oil and gas wells is now being accepted as a valuable special technical service to the Petroleum Industry.

The most far-reaching effect of acid-treating is the complete change in the attitude of the Industry toward limestone production.

The chemical reaction of HCl with limestone itself is very simple, but the disposal of residue products of this reaction may be more difficult. It is possible that the deposition of insoluble residues may reduce or even nullify completely the good effects of opening the pore-spaces with acid.

Acid treatment has resulted in more coring, and core analysis now includes qualitative and quantitative determinations of core materials as well as more extensive studies of porosity and permeability.

Selective treatment of the various strata penetrated has resulted in the development of congealing fluids. If formations containing oil, gas or water separately may be treated for one with little or no effect upon the others, gas/oil and water/oil ratios may be corrected intelligently. L. V. W. C.

1123. Methods of Operating High-Pressure Gas Wells. F. B. Frank. *Oil Weekly*, 12.7.37, **86** (5), 34.—The difficulties encountered in taking a small percentage of the open flow of high-pressure gas wells may be classified in different groups namely :—(1) regulation of deliveries, (2) elimination of freezing, (3) removal of fluid and (4) measurement.

A cutting device to regulate the deliveries and to reduce pressures has overcome these difficulties. A hot-water heater has eliminated freezing, separator connections and drips remove the fluid and an orifice meter measures the flow. These installations are usually made at some distance from the well, easily accessible by car.

The well hook-ups and the apparatuses used for the elimination of the various troubles are dealt with in detail. L. V. W. C.

1124. Diesel-Electric Power Replaces Gas-Engine Drives when Gas Supply Dwindles. L. H. Towers. *Petr. Eng.*, July 1937, **8** (11), 36.—A shortage of natural gas on leases near Nocona, Texas, has forced the Continental Oil Co. to turn to electric power generated by its own plant to pump the wells economically.

In all, 142 wells will be pumped from 12 central powers, the power for which will be supplied by the central power plant. L. V. W. C.

1125. Maintenance Methods for Water Pumps. W. Varley. *Oil Weekly*, 12.7.37, **86** (5), 20.—The majority of water-pump failures are due to neglect and abuse and may be materially reduced by simple systematic inspection and care. The methods to be carried out for the various individual parts are described in detail.

L. V. W. C.

1126. A Successful Water-Flooding Project near Kanesholm, Pennsylvania. J. C. Albright. *Petr. Eng.*, July 1937, **8** (11), 58.—The Olean Petr. Co.'s lease near Kanesholm is approximately 5300 acres in extent and both the water input wells and oil wells are about 2100 ft. deep. All old producers are rejected and are carefully plugged to prevent loss of oil or undesirable migration of flood waters as the flood project progresses across the property.

Small individual well pumping units, powered by electric motors of small h.p., are used, the power being generated by four units housed in a central power house.

Approximately 6000 brls. of water are being used daily on the lease, and centrifugal pumps are being operated to force the required volume to the input wells.

In addition to handling the water, producing, circulating, filtering and transmitting to the various sections of the lease, the equipment in the power house also produces sufficient electrical power for pumping all water-flood oil wells and for operating the machine shop. L. V. W. C.

1127. Cleaning Out Shallow Wells with Cable Tools. K. C. Sclater. *Petr. Eng.*, July 1937, **8** (11), 30.—Maintaining more than 300,000 stripper wells in the U.S. is a task of considerable magnitude. Great improvements in the methods of producing these wells and in keeping them in repair have taken place in recent years. Secondary methods of recovery have given many of these wells a new lease of life, and the necessity for keeping them in good repair is emphasized when these methods of recovery are adapted.

Cable tools are in general use for this work in conjunction with portable rig equipment. Small diameter strings are used with the jars placed on the lower end of the stem.

The modern portable equipment used can be handled easily by two men, and a rough average time for cleaning each well is 10 daylight tours. L. V. W. C.

Transport and Storage.

1128. Cleaning Line-Pipe. F. B. Taylor. *Oil Weekly*, 5.7.37, **88** (4), 44.—The cost of cleaning line-pipe depends upon the cost of removal, storage and reconditioning. The Oklahoma Natural Gas Company have reduced these costs to a minimum by the erection of a blast furnace at a point centrally located in the firm's Mid-Continent area of activity.

The used pipe is conveyed into and out of the furnace on small carriers mounted on a double rail. The track is 65 feet in total length.

Gas is controlled through manifolds located at each side of the body of the furnace. An outer shell carries the air and the gas is injected through minor lines.

When the walls of the furnace reach the operating temperature a length of pipe is inserted and allowed to remain in the furnace a predetermined time. The burned scale is removed by brushing. L. V. W. C.

Crude Petroleum.

1129. Analyses of Michigan Crude Oils. Anon. *Petr. Eng.*, July 1937, **8** (11), 66.—U.S. Bureau of Mines Report of Investigations 3346 by E. L. Garton gives analyses

of 13 fields in eight counties in the lower peninsula. The oils are predominantly paraffin, intermediate base, wax-bearing crudes and yield 25–35% of highly paraffinic gasoline, about the same percentage of kerosine and gas oil combined, 12–15% of lub. oil stock and 20% of residuum with a carbon residue of 6–7%.

The report also shows the correlation between certain properties of the crude oils and the geographical location and the geological structure of the oil-producing areas within the state. It is mentioned that out of the total area of Michigan (37 million acres) 20 million acres have been classified as possible oil-producing areas, out of which only 5 million acres have been prospected. C. L. G.

1130. Patents on Crude Oil. J. W. Hays. U.S.P. 2,082,337, 1.6.37. Apparatus for dehydrating emulsions.

M. de Groote and B. Keiser. U.S.P. 2,083,220, 8.6.37. Breaking petroleum emulsions using as demulsifying agent derivatives of blown castor oil.

M. de Groote. U.S.P. 2,083,221, 8.6.37. Process as described above using as demulsifying agent a condensation product of urea with ethylene oxide.

M. de Groote. U.S.P. 2,083,222, 8.6.37. Process as described above using as demulsifying agent a hydroxysulphonic acid derived from aliphatic hydrocarbons, *e.g.* water-soluble triethanolamine salt.

M. de Groote. U.S.P. 2,083,223, 8.6.37. Process as described above using as demulsifying agent a water-soluble salt, *e.g.* (OH)T(D) : (SO_4Z) when T, OH are phenyl residues, D is cetyl radicle and Z is an alkylolamine radicle.

M. de Groote. U.S.P. 2,083,224–5, 8.6.37. Demulsifying petroleum emulsions using a tetraethylene pentamine salt of propylated naphthalene mono-sulphonic acid admixed with a suitable solvent.

M. de Groote and A. F. Wirtel. U.S.P. 2,085,298–9, 29.6.37. Demulsifying petroleum emulsions using an amylaminopropanol salt of amylated naphthalene monosulphonic acid. W. S. E. C.

Cracking.

1131. Patents on Pyrolysis. C. A. Thomas. U.S.P. 2,084,012, 15.6.37. Pyrolysis of hydrocarbons, *e.g.* kerosine, to produce resins: the pyrolysed product is then polymerized in the presence of aluminium chloride. W. S. E. C.

1132. Patents on Cracking. A. E. Hassler and H. W. Field. U.S.P. 2,081,927, 1.6.37. Heat distributor for use in furnaces.

J. G. Alther. U.S.P. 2,081,970–1, 1.6.37. W. W. Gary. U.S.P. 2,084,277, 15.6.37. M. W. Barnes. U.S.P. 2,084,307, 22.6.37. Improved furnace for cracking plants.

P. C. Keith, Jr. U.S.P. 2,082,636, 1.6.37. Pyrolytic conversion of gas into motor fuel. W. S. E. C.

Hydrogenation.

1133. Carbon Dioxide Scrubbing by Amine Solutions. L. B. Gregory and W. G. Scharmann. *Ind. Eng. Chem.*, 1937, **29** (5), 514.—Studies were made on the scrubbing of hydrogenation process gas for the removal of CO_2 by water solutions of monoethanolamine, triethanolamine and diamino*iso*propanol. The first and last of these are about equally effective from the standpoint of absorption capacity and speed.

From the small-scale tests diamino*iso*propanol (Dapol) was selected for use on the large scale. The plant operated satisfactorily, but corrosion difficulties were encountered which were traced to the presence of small quantities of oxygen, which must be removed or prevented as far as possible for satisfactory operation. P. D.

1134. Patents on Hydrogenation. N.V. de Bataafsche Petroleum Mij. E.P. 467,470, 17.6.37. Catalytic dehydrogenation of aliphatic hydrocarbons containing at least two carbon atoms in the molecule in the vapour phase at 500–800° C. using as catalyst nickel sulphide, activated charcoal and a controlled amount of H_2S and water vapour.

J. E. Harvey, Jr. U.S.P. 2,082,885, 8.6.37. Production of wood preservative by hydrogenation of pitch obtained from coal-tars and rosin pitch. W. S. E. C.

Polymerization.

1135. Patents on Polymerization. W. E. Kuentzel and R. F. Ruthruff. U.S.P. 2,082,454, 1.6.37. Polymerization of ethylene hydrocarbons at 300–750° F. and under 200–3000 lb. pressure per square inch using as catalyst sodium chloro-aluminate.

W. E. Kuentzel. U.S.P. 2,082,500, 1.6.37. Catalytic polymerization of olefines as described above using as catalyst a double salt of ferric chloro-aluminate.

R. F. Ruthruff. U.S.P. 2,082,518, 1.6.37. Catalytic polymerization of paraffins and olefines of m. wt. above that of ethylene into hydrocarbons of high m. wt. The hydrocarbons are brought into contact at high temperatures and pressures with a stable double salt of aluminium bromide and a metallic halide, *e.g.* mercuric antimony or bismuth bromo-aluminate.

R. F. Ruthruff. U.S.P. 2,082,519, 1.6.37. Catalytic polymerization of olefines using as catalyst a double salt of sodium and aluminium chloride.

R. F. Ruthruff and W. E. Kuentzel. U.S.P. 2,082,520, 1.6.37. Catalytic polymerization of a gaseous mixture containing paraffins and propylenes and butenes using as catalyst sodium chloro-aluminate.

M. de Simó and F. B. Hilmer. U.S.P. 2,085,525, 29.6.37. Stabilization of polymers prior to adding to lubricating oils, by subjecting them to a milling operation in a colloid mill.

S. L. Langedijk and A. J. van Peski. U.S.P. 2,085,535, 29.6.37. Polymerization of unsaturated hydrocarbons using a complex catalyst obtained by combining an active inorganic halide of the Friedel Craft type with an organic sulphone of not more than 15 carbon atoms. W. S. E. C.

Refining and Refinery Plant.

1136. Fractionation of Michigan Straight-Run Naphthas. S. Lawroski, C. O. Tongberg, A. A. Mazzarola and M. R. Fenske. *Ind. Eng. Chem.*, 1937, **29** (6), 674.—Two naphthas of boiling range (A.S.T.M.), 44–134° C. and 157–206° C., were fractionated to give a series of fractions varying from 0·3 to 0·6% on charge, in a 75 plate column at a reflux ratio of 40 : 1. The Cottrell spread of the fractions (varying from 0–2° F.), refractive indices and boiling points are recorded graphically, and the concentration of benzene and toluene in the individual fractions given in tables.

Four normal paraffins were isolated in approximately 90% purity, and the authors point out that the naphthas studied provide an excellent source for such materials. P. D.

1137. Bubble-cap Column as a Liquid–Liquid Contact Apparatus. M. C. Rogers and E. W. Thiele. *Ind. Eng. Chem.*, 1937, **29** (5), 529.—A three plate column was used to extract a heavy motor oil with chlorex. The bubble-caps were modified to give the best dispersion of one phase in the other, as judged by observation of the column through a glass window. Even under the most favourable conditions the action of the three plates gave a degree of refining less than can be achieved in one perfect stage, and in view of the very low efficiency it is concluded that the bubble-cap column does not compare favourably with the packed column for solvent extraction work. P. D.

1138. New Tide-Water Butane–Propane Unit is Finished. H. S. Norman. *Oil & Gas J.*, 1.7.37, **36** (7), 28.—A propane–butane unit has recently been completed at Bayonne and has been in operation for a few weeks. Overhead vapours from a gasoline-recovery unit are condensed in salt-water condensers and collected in a reflux accumulator which acts now in the dual capacity of storage tank for reflux to that tower and feed tank for the butane tower. Feed must be pumped through steam heaters to the butane tower as the latter operates at approx. 50 lb. greater pressure than the preceding one. Commercial butane is withdrawn from the reboiler through a salt-water cooler to butane storage tanks. Overhead vapours from this tower are condensed in the butane reflux condenser. As described for this tower, the feed is pumped to the propane column, operating at 450 lb. pressure. Commercial propane from the bottom of this tower flows through an exchanger, preheating the feed, previous to the water cooler from which it flows to propane storage tanks. The overhead from this column is condensed to supply necessary reflux. Water is removed with the ethane and lighter in overhead vapours. A flow sheet giving principal dimensions, number of plates, etc., is provided. Propane free of moisture and passing the cobalt-bromide test is obtained direct from the plant without resorting to the installation of special dehydrating equipment. The purity of both propane and butane produced was 99·4%. Operating pressures and temperatures, steam and cooling water usage, and heat-exchange rates determined during a test period are given. At this time there was an inadequate supply of gas to the plant, but the recoveries obtained were: propane 99·2%, butane 91%. The gas processed at the time contained 87·4% propane and 3·8% of *n*- and *iso*-butane, and daily yields of 25,680 gals. of propane and 1215 gals. of butane were obtained. For the present it is proposed to operate for a maximum of 25,000 gals. per day of propane and 5000 gals. of butane. A recovery of 97·8% of butane is anticipated on a 5000 gals. a day recovery basis. R. A. E.

1139. Patents on Plant. N.V. de Bataafsche Petroleum Mij. E.P. 467,617, 21.6.37. Process for the fractional condensation and/or distillation of hydrocarbon oils in one or more fractionating columns.

J. N. Garrison. U.S.P. 2,084,768, 22.6.37. Fractionating tower for fractional distillation of hydrocarbon oils.

F. L. Fast. U.S.P. 2,085,422, 29.6.37. Improved method of distillation of heavier fractions of crude petroleum oils. W. S. E. C.

Corrosion.

1140. Evaluating Alloy Steel Tubes for Cracking Still Service. W. L. Nelson. *Oil & Gas J.*, 26.6.37, **36** (6), 79.—Tabulated data are given and discussed on (1) the relative scaling tendency, cost and strength, (2) the relative life and cost of maintenance and (3) the approximate sulphur-corrosion resistance of carbon and alloy steel tubes for use in cracking plants.

In addition to higher corrosion resistance the more expensive alloy steels show an advantage over carbon steels in their resistance to oxidation and their general strength at high temperatures, this being of great importance even in cases where corrosion is low or overcome by neutralization. The addition of Cr, Mo and Si improve the scaling resistance or the creep strength, the latter feature in Mo outweighing its lack of value in the former direction. The table provided showing relative penetration by scaling of different steels gives figures of 0·01 for 13 Cr and 18–8 Cr–Ni steels as compared with 1 for carbon steel, that of Mn–Mo steel being, however, 1·35. A second table gives the cost, thickness necessary for strength, thickness available for scaling, relative length of service and relative cost of unit time of service of 17 alloy and carbon steels of 2 in. inside diameter, ½ in. thickness when used under cracking conditions (1000 lb. per sq. in. pressure and 1000° C.). It is shown that only 0·045 of the carbon steel is available for corrosion, whereas 0·284 in. of the carbon–Mo steel may be lost by scaling before the tube becomes dangerously weak. It will therefore last 5·57 times as long, giving a quarter of the relative cost of unit time of service. The greatest relative length of service is given

by 18–8 Cr–Ni (695) with a relative cost of unit time of service of only 1% of that of carbon steel. With tubes of greater thickness, alloy tubes show up more favourably still with the exception of those which oxidize rapidly. A table of the approximate resistance of tube materials to sulphur corrosion gives the 13 Cr alloy a relative penetration of 18% of that of carbon steel, so that although it costs 9 times as much, it will last 340 times as long when a tube thickness of ½ in. is used. In terms of cost of tube replacements the 13 Cr steel will cost only about 3% as much as carbon steel. C. L. G.

1141. Progress in Metals. W. L. Nelson. *Oil & Gas J.*, 1.7.37, **36** (7), 49.—Brief notes describe: (1) The welding of stainless steel; (2) a nickel alloy, Inconel, for pump barrels which resists the corrosion to which regular steel barrels are subject in the Goose Creek field, Texas; (3) fatigue limit of three common sucker-rod materials and the effect of corrosion on this limit; (4) the value of sorbite, a particular heat-treated form of steel, in the manufacture of sucker rods and the method employed in the preparation of the rods. R. A. E.

Chemistry and Physics of Petroleum.

1142. Combustion of Paraffin Hydrocarbons. G. von Elbe and B. Lewis. *J.A.C.S.*, 1937, **59**, 976–984.—This theoretical paper considers certain shortcomings in existing oxidation theories which the proposed theory aims to overcome. Aldehyde oxidation is considered from the point of view of a chain mechanism which is linked with the chain mechanism for hydrocarbon oxidation. The high-pressure oxidations of methane and ethane are related to the chemistry of peroxides. Low-temperature "peroxide branching" and high-temperature "peracid branching" are proposed. The mechanisms of primary aldehyde forming reactions and secondary non-chain reactions are discussed. Kinetic facts concerning the slow reaction and explosion limits of methane are consistent with the scheme. Certain phenomena exhibited at relatively low temperatures by higher hydrocarbons, *e.g.* "cool" flames, explosion peninsula, etc., can be described by peroxide branching, whilst peracid branching will describe the explosion limits of higher hydrocarbons at high temperatures. W. E. J. B.

1143. Phase Equilibria in Hydrocarbon Systems. XVIII. Thermodynamic Properties of Ethane. B. H. Sage, D. C. Webster and W. N. Lacey. *Ind. Eng. Chem.*, 1937, **29** (6), 658.—The apparatus used in previous researches in this series for the determination of specific volume was modified and used to determine the specific volume of ethane over the temperature range 70–250° F., and pressure range 0–2500 lb./sq. in. The results are presented in the form of graphs showing the deviation factor from the gas laws. The specific heat at constant volume and the Joule-Thomson coefficients were also determined, and the data used to provide temperature–entropy and temperature–heat content diagrams. P. D.

1144. Study of the Crystal Behaviour of Hydrocarbons. R. T. Leslie and W. W. Heuer. *Bur. Stand. J. Res.*, 1937, **18**, 639–644.—The study of the properties of crystals of various hydrocarbons offers a possible means of identifying the chief constituents of a mixture without actually separating the materials.

A microscope was constructed for the observation of the growth of crystals at low temperatures. This is described, a detailed diagram being given and the mode of operation explained.

A great deal of experience was required to grow crystals which were satisfactory for study, and the hydrocarbons differed greatly in the ease with which they formed large easily observable crystals. As much as 3 or 4 hours of patient warming and cooling was required for many of the subjects.

Photomicrographs of 9 aromatics, 6 *cyclo*paraffins, 8 normal paraffins and 5 branched-chain paraffins were obtained and are reproduced in this paper. No differences in crystal appearance could be detected among the successive members of the homologous series of *n*-paraffins. However, it was observed that condensed mole-

cules tended to crystallize in polyhedrons of about equal dimensions whilst molecules with long chains tended towards long prisms.

Mixed molecules showed modified forms depending on the relative influence of the chain and the condensed groups. D. L. 8.

1145. Preparation and Cracking of High Molecular Weight Nitriles. A. W. Ralston, H. J. Harwood and W. O. Pool. *J.A.C.S.*, 1937, **59**, 986–992.—Nitriles have been prepared by heating fatty acids in a stream of ammonia. The reaction occurs as below

$$R\,COOH + N\,H_3 \longrightarrow R\,COON\,H_4 \longrightarrow H_2O + R\,C\,O\,N\,H_2 \longrightarrow R\,C\,N + H_2O$$

The reaction is carried out in the liquid phase, at a temperature of 330° C. in the case of stearonitrile, and has been used to make nitriles from a variety of higher fatty acids. These high molecular weight nitriles have been cracked in the liquid and vapour phase to yield hydrocarbons and nitriles. The hydrocarbons are of straight-chain constitution and in certain fractions, saturated and unsaturated hydrocarbons, were present in equal amounts.

The separation of the hydrocarbons from the nitriles is discussed. Adsorption methods appear preferable to solvent methods. W. E. J. B.

1146. Reaction between Sulphur Dioxide and Olefins and Acetylenes. L. L. Ryden, F. J. Glavis and C. S. Marvel. *J.A.C.S.*, 1937, **59**, 1014–1015.—Ascaridole has been shown to be an active catalyst for the reactions between sulphur dioxide and olefins of the type $R\,C\,H = CH_2$ and acetylenes of the type $RC \equiv CH$. Results of experiments are listed, with some data on the polysulphones formed. W. E. J. B.

1147. Densities and Vapour Pressures of Some Alkylbenzenes, etc. J. C. Rintelen, J. H. Saylor and P. M. Gross. *J.A.C.S.*, 1937, **59**, 1129–1130.—The authors have determined the vapour pressures of the following hydrocarbons at 10, 30 and 50° C.: Ethyl benzene, *o*-, *m*- and *p*-xylene, and mesitylene. The densities and vapour pressures of various ketones have also been determined, *viz.* methyl *iso*propyl, methyl butyl, methyl *iso*butyl, di-ethyl, dipropyl and dibutyl. W. E. J. B.

1148. Heat Effects in Capillary Flow at High Rates of Shear. M. D. Hersey and J. C. Zemmer. *J. Applied Physics*, 1937, **8** (5), 359.—When oils are caused to flow through capillaries under high rates of shear (of the order of one million reciprocal seconds), the pressure drop is affected by the heating of the oil. This effect cannot be allowed for by measurement of the temperature of efflux. An equation is developed by means of which due allowance may be made, and is applied to a series of experimental results. P. D.

1149. Viscosities of Liquid–Solid Systems: Influence of Dispersed Particles. R. N. Traxler, H. E. Schweyer and L. R. Moffatt. *Ind. Eng. Chem.*, 1937, **29** (5), 489.—Dispersion of solid particles in a liquid increases the viscosity, and the work described is a study of this effect when various solids such as diatomaceous earth, mica, slate and limestone are dispersed in asphalts. It is shown that a linear relation exists between the volume percentage of a particular solid added and the logarithm of the viscosity. This allows a simple "stability index" to be evaluated for each solid, namely the percentage increase in viscosity resulting from additions of one per cent. by volume of the solid. This ranges in value from 4·5 for limestone to 21 for asbestos powder. It was further found that the Stability Index for any solid was the same whether it was dispersed in hard asphalt, soft asphalt or a bakelite resin.

The viscosity of a mixture of a particular powder dispersed in a given liquid is inversely proportional to the average void diameter. P. D.

1150. Adhesion Tension Measurements. A. R. Ebberts. *Proc., Jan.* 1937, *Technical Session U.S. Assocn. Asphalt Paving Technologists*, p. 68.—Data are presented and discussed on measurements of the adhesion tension of various solids and liquids using a modification of the Bartelli displacement pressure method. The apparatus used

consists of a manometer of small-bore heavy-walled tubing equipped with a burette cock at the bottom.

One leg is shorter than the other and fits into a section cut from a large test tube through a rubber bung. The apparatus is filled to just over the rubber stopper with the liquid, which is then covered with a disc of filter paper. A slurry of the liquid and uniformly divided solid is next added to a height of 1 cm. and the liquid drawn off slowly until the steady drop of the liquid level in the free leg is arrested, and begins to rise again. At this point the distance of the liquid level above the slurry level is measured. A table of the displacement heads for water, benzene, 50% solutions in benzene of paving asphalt, coke oven and low-temperature tar with various mineral solids is given. Using this figure, the effective pore radius can be calculated for any given sample of granular solid using a liquid having a zero contact angle with that solid, from the capillarity equation $r = \frac{2SK}{hsg}$, where r is the effective pore radius, S is the surface tension of the liquid, K is the cosine of the contact angle, s is the density of the liquid, g the gravity constant and h the displacement head. Thus, knowing the value of r for any solid, a measurement of h provides a means of determining the contact angle of the solid with any liquid whose surface tension is known. The adhesion tension (net change in free surface energies resulting from wetting the solid with the liquid) is expressed by the product of the liquid surface tension and the cosine of the angle of contact. The apparatus can similarly be used for determining the angle of contact of water with various organic liquids.

Reference is made to the effect on the results of, *e.g.*, reactions between acidic components of bituminous materials and basic aggregates. The presence of tar bases in a low-temperature tar is believed to account for its resistance to washing from acid aggregates. It is suggested that the incorporation of cracked stock or tar into paving asphalts deficient in polar groups may be beneficial. Limestone when heated changes from the hydrophilic to the hydrophobic state while siliceous materials adsorb water, thereby affecting their surface energy. It is therefore necessary that paving materials should be tested in the condition in which they are to be used, particularly as regards temperature. C. L. G.

1151. Liquid Film in Gas Absorption. M. H. Hutchinson and T. K. Sherwood. *Ind. Eng. Chem.*, 1937, **29**, 7, 836.—Absorption experiments were carried out in which helium, acetylene, nitrogen, oxygen, carbon dioxide, sulphur dioxide and chlorine were absorbed in water in a glass flask, with the gas exposed above a stirred water surface.

At the higher stirrer speeds the liquid film coefficient is proportional to the 0·6 power of the speed, and in this range it was found that the liquid film coefficient for eight different gases at a given stirrer speed showed a maximum variation of 20% from the mean values. It is concluded that the liquid film coefficient is substantially independent of the nature of the solute gas. P. D.

Analysis and Testing.

1152. Use of the A.S.T.M. Penetration Equipment for Estimating the Viscosities of Materials of High Consistency. E. O. Rhodes and E. W. Volkmann. *J. Applied Physics*, 1937, **8**, 7, 492.—The use of the penetrometer as a means of determining viscosity has been previously discussed by Saal (*J.I.P.T.*, **19**, 176), Traxler (*Physics*, **6**, 58), Thelen (*J. Applied Physics*, **8**, 135) and others. In particular the values of the absolute viscosity as deduced by Saal and by Thelen are in poor agreement. In this paper a new method of analysing Thelen's results is described, which is based upon the determination of viscosity by the axial displacement of concentric vertical cylinders. The resulting equation is similar in form to Saal's empirical equation. The viscosities of a pitch determined by penetrometer as by capillary rise viscometer agreed within 1%. P. D.

1153. Mineral Oils for Electrical Purposes. H. Weiss and T. Salomon. Brochure 8, Austrian Petr. Inst., *Petr. Zeit.*, 14.7.37, **33** (28),1.—This is a reprint of a brochure of the Austrian Petr. Inst., and it deals with the electrical and chemical properties of

mineral oils, especially ageing tendencies of insulating and turbine oils. The determination of such properties as conductivity and resistivity are detailed, also the use of the tensiometer for determining the surface tension between oil and water.

Regarding sludge-formation, the influence of temperature is studied and illustrated with graphs. Results are given for new and used oils. In the case of turbine oils the tendency to form emulsions decreases with increasing degree of refining and increases on ageing. Generally, oils which have formed no sludge tend to give rise to none or very little emulsion. W. S. E. C.

Motor Fuels.

1154. Researches on the Synthesis of Gasoline from CO and H_2 at the Imperial Fuel Research Committee. S. Tsutsumi. *J. Fuel Soc. Japan*, 1937, **16** (177), 55.—A discussion is presented of the effect of different types of catalysts on the yields of gasoline obtained by the synthesis of CO and H_2, and of the mechanism of the action of catalyst promoters.

The activity of Ni and Co catalysts was considerably increased by the addition of small amounts of irreducible metallic oxides of, *e.g.* Th, Al, V, Mn, Cr, etc., the promoting action being attributable to their preventing the sintering of the reduced Ni and Co at the higher reduction temperature. As a guide to the catalytic synthesis of CO and H_2, an examination was made of promoter-catalyst synthesis in the hydrogenation of benzene, using nickel catalysts prepared by roasting and by precipitation. The precipitated catalyst was considered superior to the roasted, owing to the occlusion of the potassium salts with the promoter and carrier, thus suppressing their harmful effect. With various catalysts the following yields of gasoline were obtained: Ni + 10% Al_2O_3 + Kieselguhr 112·5 cc./m.³; 2 Ni + 1 Co + 10% Al_2O_3 + Kieselguhr 125·0 cc./m.³; and 1 Ni + 1 Co + 10% Al_2O_3 + Kieselguhr 132·6 cc./m.³.

Although increase of pressure should accelerate the CO and H_2 reaction, it increases the formation of alcohols, aldehydes and ketones, as well as of solid paraffins, and shortens the life of the catalyst.

The acceleration of the formation of solid paraffin is considered due to the elevation of the catalyst temperature by the heat of reaction as well as to the increase of added amounts of U and Th oxides to Ni and Co catalysts. Reaction pressures of 5–10 atmos. were considered to have the optimum industrial potentialities, owing to slightly higher yield of gasoline, as well as to the smaller catalyst chamber required.

C. L. G.

1155. Catalyst for the Production of Synthetic Gasoline. G. Kita. *J. Fuel Soc. Japan*, 1937, **16** (177), 60.—A further discussion is presented on the suitabilities of different types of catalysts used in the production of synthetic gasoline in the Fischer process.

Fe catalysts are of low activity, producing about ¼ of the yield of gasoline given by more effective catalysts.

Co catalysts with accelerators, particularly ThO_2 and U_3O_8, give good yields, the quantity required being reduced to ¼ if pumice is used as the carrier. Increased yields are given by the addition of sucrose which increased the porosity by decomposition of $CO(NO_3)_2$ at high temperatures.

Ni catalysts are highly susceptible to manufacturing conditions and should be prepared by settling with the addition of alkali carbonate, and reduction should be carried out at 450° C., while the Ni should not contain more than 0·5%, and must contain an irreducible oxide accelerator plus a small quantity of alkali. The substitution of Al_2O_3 or acid clay for ThO_2 as an accelerator gave improved results.

Alloy catalysts made from Ni–Co–Al–Si alloy from which Al or Si is extracted with alkali, has the advantage of small volume, high thermal conductivity and granular form.

Ni–Co settled catalysts of composition 50% Co + 50% Ni + 15% Mn + 3% ThO_2 + 5% U_3O_8 + 125% Diatom. earth gave the highest yield of gasoline obtained in these tests (166 cc./m.³ of gas). C. L. G.

1156. Patents on Motor Spirit. F. Gardner. U.S.P. 2,082,331, 1.6.37. Sweetening of cracked gasoline using an aqueous solution of alkaline plumbate.

A. E. Birch. U.S.P. 2,082,787, 8.6.37. Removal of dispersed residual blackstrap from a plumbite sweetened oil by emulsifying the blackstrap remaining in the oil by means of an aqueous solution of caustic soda.

E. J. Houdry. U.S.P. 2,082,801, 8.6.37. Production of high octane gasoline by continuous once-through distillation of crude.

I. Budowski. U.S.P. 2,083,253, 8.6.37. Refining of hydrocarbons containing undesirable unsaturated hydrocarbons by oxidation with powdered alk. bichromate and adding conc. sulphuric acid slowly. The reaction mixture is allowed to settle and the treated hydrocarbon separated.

J. M. McGee. U.S.P. 2,083,917, 15.6.37. Sweetening of gasoline by adding elementary sulphur and subjecting the gasoline to the action of calcined MgO.

H. W. Seyler and J. H. Wells. U.S.P. 2,084,223, 15.6.37. Recovery of light oil from coke-oven gas.

C. A. Day, Jr. U.S.P. 2,084,575, 22.6.37. Refining of gasoline containing mercaptans without conversion to disulphides by commingling the gasoline with aqueous NaOH containing alcohol and approx. 50% by vol. of petroleum naphthenic acid products.

A. Belchetz and B. R. Carney. U.S.P. 2,085,523, 29.6.37. Sweetening of light distillates using slaked lime while stirring in a solution of $FeSO_4$ in water to give a ppt. containing at least 25% of free CaO. The ppt. is dried to free the water content of at least 5% and not more than 30%. The dried mass is contacted with a solution containing mercaptans in the presence of free sulphur to complete the sweetening process.

S. M. Gregory. U.S.P. 2,085,527, 29.6.37. Neutralization of acid-treated distillate and oxidation of certain oxidizable compounds contained in the distillate by means of MnO_2. W. S. E. C.

Lubricants and Lubrication.

1157. Effect of Temperature and Pressure on the Viscosity of Lubricating Oils. R. B. Dow. *J. Applied Physics*, 1937, **8** (5), 367.—The viscosities of three lubricating oils from different sources, all having the same viscosity at 130° F. and one atm., were measured over the range 1 to 4000 atms. at temperatures of 100, 130 and 210° F. The marked differences between them may be illustrated by the fact that at 130° F. and 26,000 lb./sq. in. the viscosity of the Pennsylvanian oil had increased 25-fold, the Oklahoma oil 35-fold, and the Californian oil over 100-fold. The effect of pressure on the temperature coefficient of viscosity and of temperature on the pressure coefficient is discussed. P. D.

1158. Solvent Refining of Lubricating Oils: The Operator's Viewpoint. V. A. Kalichevsky, T. P. Simpson and B. W. Story. *Oil & Gas J.*, 3.6.37, **36** (3), 88; *Refiner*, 1937, **16**, 250.—It is possible for a solvent to extract compounds of low mol. wt. of a relatively paraffinic nature and fail to remove others which are relatively more aromatic but of higher mol. wt. It may therefore be inadvisable to solvent-refine a very wide fraction or a blend of widely different stocks. The stock may be over-refined on the lighter end and under-refined on the heavier end. This may not be evident from the V.I., but oxidation resistance under certain conditions may be affected. Practically all of the commercially used solvents give about the same quality and yield of raffinate from a given charging stock if the best treating conditions are used for each solvent. However, all solvents will not operate upon all charging stocks with equal economy as some solvents are better suited to handle certain stocks than others. This does not apply to the treatment of residuum stocks where a large amount of asphaltic matter is present. Combination deasphalting and solvent-refining processes are particularly suited to such stocks, but this advantage disappears in the absence of asphalt. Charging stock is the most important factor in solvent refining, and while it may not determine the process to be used, it will

strongly influence the choice of treating conditions as well as yield and quality of product.

Light oils of a predominantly aromatic or naphthenic character require lower treating temperatures than heavy oils of a paraffinic nature. A higher V.I. may usually be obtained with solvents than with acid from a given stock, but a point is reached where the V.I. increases very slowly while the yield decreases rapidly, so that there is an economic V.I. limit. It is not always advisable to refine stock to the economic V.I. limit because a distinct loss in oxidation resistance may develop before that point is reached. Separation difficulties, effects of temperature control throughout the system, of variations in solvent ratio and of addition of water toward the extract end are discussed. No one process is best for every stock and therefore no single stock can be used for such a comparison except by the refiner interested solely in that particular stock. Charging capacities of lubricating oil solvent-refining plants throughout the world are summarized under processes.

Considering V.I., carbon residue and oxidation stability of petroleum oils as measures of oil improvement, the advantages of solvent-refined over acid-refined oils may be easily observed, and data are presented in support of this. No convincing data have been published so far to show that solvent-refined oils differ from acid-refined with respect to oiliness and wear when strictly comparable test conditions were employed. Results of tests carried out on Timken and Kingsbury machines show little difference between the two types when produced from the same base stock. In the early stages of development corrosion experienced with the newer higher-strength bearing alloys was attributed to solvent-refined oils. Subsequently it was discovered that these troubles were usually due to excessive crankcase temperatures set up by sustained high-speed driving. Research showed that typical solvent-refined oils were less prone to corrode bearings than conventionally refined Pennsylvanian oils, but more prone to do so than Coastal oils, which tended to form sludge rather than acids during oxidation. Practical experience over a period of 4 years or more, particularly in the aviation industry, has shown conclusively that solvent-refined oils are far superior to any oils previously available. R. A. E.

1159. Hypoid Rear-Axle Design and Lubrication. W. R. Griswold. *J.S.A.E.*, 1937, **40** (5), 194–205.—Comparing the spiral-bevel with the hypoid gear, in the case of the former the pitch surfaces are cones which may rotate about their axes with pure rolling motion on their contacting surfaces. In the case of the hypoid the pitch surfaces are hyperboloids of revolution, and in appearance approximate sections of cones, whilst the motion is a combination of rolling and sliding. As far as the tooth action is concerned the involute tooth action in the spiral bevel gear is only slightly different from that in spur gears. Actually at points of contact other than at the pitch line there is involved a slight (negligible) sliding action along the tooth. In the hypoid gear, in addition to the involute sliding action there is a relative sliding motion longitudinally along the teeth. The most important factor affecting slide in the hypoid gear is the pinion offset. Although maximum tooth loading is less with the hypoid gear than with the bevel gear, because there are more pairs of teeth in contact, the advantage of the finer pitch which may be used may be offset by deformation of teeth, mountings, bearings, pinion shaft, differential case, &c. Deformation can be ascertained by taking contacting patterns using red lead on the teeth, and can be reduced by preloading the differential bearings, now universal practice. In some types of design it is common to have from 1000 to 1500 lb. axial loading. It is considered that manufacturing precision such as lapping and mirror-finishing of balls and grooves, and lapping of teeth and their spacing, is now rapidly approaching the limitations of practical measurement. All the great pains taken in precision building may be destroyed in a short time by the use of a poor E.P. lubricant. To bring the requirements of a lubricant into a clearer focus, they are listed under three headings:

(1) A film must be provided under all conditions of load, speed and temperature, *i.e.* the lubricant must be stable from the point of view of its load-carrying capacity both in service and in all conditions of storage.

(2) The oil must not cause or contribute to wear of gears or bearings, *i.e.* it must not be abrasive when new or develop abrasiveness.

(3) The lubricant shall not have any harmful chemical activity, *i.e.* such as to

cause deterioration of material. More exactingly it must not have any chemical effect beyond that existing with straight mineral oils.

As far as the testing of the lubricant is concerned it is pointed out that film-strength testing machines may rate the new lubricant adequately, but the duplication of all variables in long-time testing is too frequently impossible. In full-sized axle testing the method of running for 9 hrs. on the drive side at full motor torque in second gear and for 1 hr. in reverse at the same load, is considered preferable to that of suddenly engaging the clutch when the motor is idling, since this method can be made more severe than might be expected in normal service. Dynamometer tests at loads required to propel the car at 50 m.p.h. on level roads will give a very accurate comparison of lubricants, it is claimed. Further, useful evidence is to be obtained by analysing the oil after such testing, for load-carrying capacity, and for iron content and other substances which may indicate wear. Mention is made of clay being found centrifuged out on the inner surfaces of bearing cages, and of careful chemical analysis revealing this substance in the original oils. Finally the oil must not channel when cold or as a result of foaming (emulsification with air), which latter can also cause serious leakage as well as accelerate oxidation, and formation of coke-like bodies. Some notes on foaming and the effect on it of such variables as rate of agitation, design of gears, etc., are contributed by G. L. Neely in a discussion of the paper.

J. L. T.

1160. Patents on Lubricating Oil. E. W. Gardiner, J. W. Grune and A. L. Lyman. U.S.P. 2,082,203–4, 1.6.37. Production of lubricating oils of high viscosity index by chlorinating straight-chain hydrocarbons to a chlorine content of between 13 and 23% on a hydrocarbon-free basis, removing the unchlorinated hydrocarbons and dechlorinating the chlorinated hydrocarbons in the presence of fuller's earth, etc., at high temperatures.

K. Taylor and B. H. Shoemaker. U.S.P. 2,083,247, 8.6.37. Rendering lubricating oils stable to oxidation and sludging by solvent treatment with dichlorethyl ether and nitrobenzene containing small quantities of aluminium chloride.

V. Voorhees. U.S.P. 2,083,250, 8.6.37. Solvent extraction of hydrocarbon oils using a mixture of liquid SO_2 and dimethyl ether.

M. H. Tuttle. U.S.P. 2,083,511, 8.6.37. Solvent extraction of hydrocarbon oil using propane, nitrobenzene, etc.

H. O. Forrest and L. Van Horn. U.S.P. 2,083,700, 15.6.37. Propane dewaxing of lubricating oils.

L. A. Clarke. U.S.P. 2,083,893, 15.6.37. Solvent refining of lub. oils using an aromatic amino-ether.

J. M. Whiteley, Jr. U.S.P. 2,084,471, 22.6.37. Solvent extraction of lub. oil using phenol as solvent and adding 10% by vol. of benzene to the oil.

M. Otto and M. Mueller-Conradi. U.S.P. 2,084,501, 22.6.37. Improvement of lub. oils or wax by the addition of high molec. wt. hydrocarbons (1000 or 2000 m. wt.), obtained by polymerizing *iso*-olefines.

J. C. Showalter. U.S.P. 2,084,510, 22.6.37. Decolorizing and imparting bloom to lub. oils by contacting the oil with spent clay at 750° F. which has been used to remove colouring material from oil.

C. C. Swoope and M. M. Sadler. U.S.P. 2,084,512, 22.6.37. Lowering the pour pt. of a narrow-cut waxy spindle oil by adding bright stock and a pour pt. inhibitor.

J. F. Bellinger. U.S.P. 2,085,069, 29.6.37. Still for the renovation of used oils.

W. J. D. Van Dijck. U.S.P. 2,085,518, 29.6.37. Solvent refining of lub. oils using furfural in the presence of an effective quantity of naphthalene. The furfural is separated from the hydrocarbons by washing with aqueous ethyl alcohol.

C. G. Verver. U.S.P. 2,085,519, 29.6.37. Dewaxing of hydrocarbon oil using a selective dewaxing diluent, *e.g.* benzene and alcohol and a pour pt. reducing substance, *e.g.* distearyl picene.

E. R. P. E. Retailliau. U.S.P. 2,085,545, 29.6.37. Refining of highly paraffinic lub. oil with sulphuric acid to form a pepper sludge and extracting the oil containing the sludge with acetone. W. S. E. C.

Asphalt and Bitumen.

1161. Production of Asphalts by Blending. A. Holmes and A. L. Raphael. *Proc., Jan.* 1937, *Technical Session U.S. Assocn. Asphalt Paving Technologists*, p. 105.—A discussion is presented of the properties of blends of asphalts of different types (*e.g.* blown, cracked and straight run) and with flux oils and of blends of the components of asphalts separated in the laboratory. The relatively low yield of bitumen in plants with poor fractionation can be improved by running to a hard grade and blending back with a heavy oil. Improved softening point-penetration relationships, with, however, higher volatility loss, are given by using lower viscosity oils. The results of blending high softening point blown asphalts with low softening point fluxes are given as :—

(1) The softer the flux, the better the softening point-penetration relationship.

(2) The low-temperature susceptibility increases with the decreasing softening point of the blown asphalt, but is less affected by the properties of the flux.

(3) The high-temperature susceptibilities are less affected although the softer fluxes tend to give better figures.

(4) The softer the hard asphalt, the better the ductility of the blend, although with the same hard asphalt the ductility does not vary appreciably with the consistency of the flux.

Blends of straight or oxidized asphalt with cracked asphalts frequently give peculiar results, *e.g.* lower viscosity than either component (straight run and cracked) or maximum softening points (blown and cracked).

The result of blending of components of bitumens (asphaltenes, resins and oily material) is of interest in view of the availability of propane precipitates from asphaltic materials, it being, however, emphasized that the asphaltic matter and resins obtained during the first and second propane treatments in practice differ from the asphaltenes and resins obtained by petroleum ether precipitation and adsorption on clay respectively.

Results of tests on blends of propane precipitates from de-asphaltized Mid-continent stock showed lower fluidity indices and improved low-temperature susceptibilities over straight-run bitumens of the same origin.

Low resin contents result in better susceptibility but lower ductilities than do high resin contents. By choosing suitable products, blended asphalt of a wide range of properties may be made. Substituting a phenol extract for the de-asphaltized oil results in considerably poorer susceptibility properties.

The inability to obtain by blending fluidity indices equal to those of straight bitumen is attributed to the absence of equilibrium in colloidal conditions in the blended bitumens unless heated for a long time at high temperatures. In an analogous manner oxidized asphalts tend to lose their consistency if maintained at high temperatures but below the cracking temperatures, equilibrium, however, being eventually reached if the heat soaking is maintained sufficiently long. C. L. G.

1162. Notes on Recovery of Asphalts from Solution. G. Abson. *Proc., Jan.* 1937, *Technical Session U.S. Assocn. Asphalt Paving Technologists*, p. 309.—A paper presented by C. Bussow at the 1936 Session on a method of recovering bitumen from paving materials is criticized, in particular the statement that the benzol used does not harden the asphalt in the absence of light, it having been suggested that light has a photo-chemical action on asphalt. The author agrees with Greutert that benzol does cause bitumen to harden and considers that in Bussow's method sufficient benzol is left behind to counteract the hardening. Data presented show little difference between the penetrations of bitumens stored in benzol in the light and those stored in the dark and subsequently recovered, the actual hardening being

attributed to the high distillation temperatures necessary; erroneous results may be given by this method owing to the varying incompleteness of removal of benzol.

In a written communication Mr. Bussow points out that the data in G. Abson's paper include figures of 43 and 38 for the penetration of a sample of 53 pen. recovered from a solution in benzol stored in the light and dark respectively, the difference indicating photo-chemical action but being considered by Abson to be within the experimental error. He agrees that benzol will be left in the flask, but if the asphalt is poured out immediately it will not condense and redissolve into the asphalt, this being supported by the relatively small change in penetration of the heating for five hours at 163° C. He repeats his claim that asphalts will not harden materially in solution in benzol during the short time required for their solution and recovery. Reference is made to extracts from literature dealing with the photo-chemical effect of the hardening of bitumen. With reference to the heating at 300° C. in Bussow's method, it is suggested that bitumens are maintained at higher temperatures in their manufacture, while the A.S.T.M. method D. 402–36 for the separation of liquid asphaltic products specifies an end temperature of 360° C. C. L. G.

1163. Asphalt Made from New Mexico Crude. S. Born. *Oil & Gas J.*, 1.7.37, **36** (7), 38.—Recently a vacuum unit was installed at Roswell, New Mexico, for the production of asphalt from New Mexico crude oils, and is the first plant of its type in that state. The oil obtained from the Getty field is particularly suitable for the production of asphalts. The crude has the following properties: A.P.I. grav. 21·6°, sulphur 1·67%, pour test below 0° F., visc. S.U. at 100° F. 390 secs., and the yields obtainable are: gasoline 6·4%, kerosine distillate 2·8%, gas oil 14·3%, lubricating oil distillate 29·0%, residuum 46·6%.

Before designing the necessary equipment a study of this crude oil was made. A flash vaporization curve was computed from vacuum distillations made according to the method described by Born and Nelson. A penetration–yield curve was also prepared. The unit, consisting of a pipe still heater, vacuum tower, barometric condenser and jets, was designed from the above laboratory data. The heater was designed so that the charging stock was raised to the required temperature in the shortest time possible and had a high radiant heat absorption. The crude is pumped continuously through one section of the pipe still heater, and then flashed to an atmospheric tower in which three cuts are produced, gasoline, kerosine distillate and gas oil. The residuum is picked up by a duplex hot oil pump and pumped through the second coil of the pipe still heater, thence through an expansion bend into the vacuum tower. Topped crude enters the heater at approx. 450° F. and leaves at 750° F. Oil enters the tower below the lowest bubble deck, superheated steam enters at the bottom of the tower through a perforated coil and passes counter-current to the descending asphalt over a series of cone-type baffles. Vapours pass upwards through the shell which contains several baffle decks and five bubble decks of special design. A horizontal condenser is placed at the top of the tower. Vapours enter at 590° F. and leave at 150° F. Two side cuts of 24–28° A.P.I. and 20–22° A.P.I. respectively are taken from this tower. Penetration asphalt is continuously removed from the bottom of the tower. The removal of asphalt, gas oil and distillate is controlled by automatic liquid level controllers. Operating on ordinary charging stock the unit yields about 30% of 100 penetration asphalt. R. A. E.

1164. Accelerated Weathering Tests of Mineral-surfaced Asphalt Shingles. H. R. Snoke and B. E. Gallup. *Bur. Stand. J. Res.*, 1937, **18**, 669–681.—These roofing materials are manufactured on an organic felt base which after impregnation with a relatively soft asphalt passes to coating rolls. While the coatings are still hot granules are embedded firmly and the finished material is cooled, cut and packed.

The paper describes a method for testing shingles by accelerated weathering and the results of tests on 39 samples of standard weight materials from eight manufacturers are reported.

An analysis of the constituent materials was also made including fibre analyses of the felts and petrographic examination of the mineral fillers and fine surfacing materials.

The samples were given a heating test to determine the percentage of volatile matter, and also accelerated blister and slide tests as developed by the industry.

The accelerated weathering test consists in exposing test pieces to the action of

light and heat from a carbon arc lamp with intermittent water spray. All the types of failure encountered in long outdoor exposures could be produced in a relatively short time by this means.

The samples exhibited a characteristic behaviour independent of the type of granular surfacing materials used which indicated that the types of asphalt and the manufacturing processes largely influenced the weathering effect.

Products containing fine mineral filler in the asphalt coatings appeared to be the most resistant to weathering but otherwise analyses showed no differences in composition sufficiently great to warrant prediction of decided differences in weathering behaviour.

The results of water absorption tests on unexposed shingles and those exposed for 1, 5 and 7 months to the accelerated weathering test are given.

The paper is profusely illustrated with photographs showing the effects of the test treatments. D. L. S.

1165. Theoretical Aspects of Asphaltic Bitumen in the Light of Recent Research. F. J. Nellensteyn. *Proc., Jan.* 1937, *Technical Session U.S. Assocn. Asphalt Paving Technologists*, p. 78.—There is general agreement on the conclusion that asphaltic bitumen is a colloidal system consisting of asphaltic bitumen micelles dispersed in an oily medium, but investigators differ as to the inner structure. The author considers asphaltic bitumen to be a highly protected lyophobe sol with a kernel of carbon and not of highly polymerized dehydrogenated hydrocarbons, based on the facts that the oxidation products contain mellitic acid and are the same as those of carbon black and various active carbons. X-ray diagrams of asphaltenes also indicate graphitic carbon. The micelle is shown to possess a kernel consisting of at least twelve carbon atoms made up of a 6-membered ring to each of the carbon atoms a further carbon atom being attached, so that the inner ring at least must be free from hydrogen or other elements. The micelle consists of at least two structural elements, one of which must be closely related to soot.

Other investigators believe that the peptizing of asphaltic bitumen is due to the aromatic properties of the reagent, but the author considers this connection accidental and due to the fact that aromatic compounds generally have higher surface tensions than the critical surface tension of asphaltic bitumen. It is pointed out that several non-aromatic compounds with surface tensions higher than 26 dynes/cm. peptize bitumens, while highly aromatic compounds, *e.g.* benzene and toluene, flocculate tars which are allied colloidal systems of highly aromatic character. A miscible liquid with a surface tension below 24 dynes/cm. at 25° C. is considered to cause flocculation and one with a surface tension about 26 dynes/cm. total peptization, in the intermediate zone the behaviour depending on the more or less stable character of the micelle.

The use of the surface tension rule enables mixtures of tar and bitumen to be analysed, using appropriate flocculating and demixing reactions.

Improved methods for the determination of the contact angle of asphaltic bitumens with water have shown that the deflection of the surface tension–temperature diagram in the region of 140° C., attributed by Saal to the strongly increasing viscosity, has no relation to the real surface tension–temperature diagram, which shows a straight line from the high temperature side of the diagram.

Reference is made to the work of various investigators on the allied tar system, which gives an insight into the constitution of asphaltic bitumen, on the plasticity of bitumens and on the adhesion of asphaltic bitumen and tar to different solids, which is ascribed to the molecular attractions in between these materials and the surrounding air, as is shown by their interfacial energies. The importance of the surface tension of the aggregate in determining the degree of wetting by the bitumen is emphasized with particular reference to the cause of slipperiness. C. L. G.

1166. Evaluation of Mineral Powders as Fillers for Asphalt. R. N. Traxler. *Proc., Jan.* 1937, *Technical Session U.S. Assocn. Asphalt Paving Technologists*, p. 60.—A discussion is presented of data obtained in an evaluation of the efficiency of mineral powder fillers for asphalt using a stability index expressed in terms of the slope of the volume composition of the asphalt versus the log-viscosity curve. A falling co-axial cylinder viscometer was developed (full description given) in which viscosities from

50,000 to 1,000,000,000 poises could be measured (corresponding to 300 to 10 pen. bitumen).

The stability index is the percentage increase in viscosity of an essentially viscous filled bitumen, resulting from an increase of 1% by volume of filler. Data on a wide range of fillers in a Venezuelan vacuum bitumen of 51 pen. include the following stability indices: coarse limestone 4·3, graphite 4·5, Portland cement 5·7, soapstone 6·1, clay 6·6, talc 7·1, mica 9·8, lime 12·0, diatomaceous earth 12·0, wood flour 16·0, asbestos 21·0.

The determination of the efficiency of fillers by bulk density or volume weight when compacted is shown to be inaccurate, the void content of the compacted powder being more reliable as it is not affected by the density of the solid. This, however, is only based on the size, size distribution and shape of the filler and is not affected by the idiosyncrasies of the filler as regards its filling efficiency. C. L. G.

1167. Selection and Use of Mineral Fillers for Low-Cost Roads. R. E. Bollen. *Proc. Assoc. Asphalt Paving Tech.*, 1937, 39–58.—The author states that opinions differ as to the importance of filler in low-cost bituminous surface designs and that while certain mixtures require a filler which will produce high stability other mixtures do not require such a filler. The fillers are largely obtained from local deposits of natural soil and the need for more complete evaluation is discussed. The ease of pulverization, quantity of effective material and quantity of bitumen required are of importance in determining cost and uniformity of the surfacing. Since natural soils may contain aggregations of particles and fine material may be lost during mixing and drying operations, it is suggested that the effective material and subsequently the amount of bitumen required, can be more accurately determined by averaging the percentages passing the 200-mesh sieve by dry and wet sieving of the combined aggregates after drying. Swell tests on filler-bitumen mixtures are believed to be more conclusive than on complete mixtures. Soil tests which are believed to be of assistance in evaluating mineral fillers are the hydrometer test, shrinkage ratio, liquid limit, plastic limit, plasticity index and cementation test. Methods of determining the stabilizing action of mineral filler are discussed and results of consistency determinations of mixtures of two asphaltic oils with varying percentages of a number of fillers are given, the consistencies were determined by means of the float test and Furol viscometer. Results show considerable differences in ability of mineral fillers to change the consistency of bitumen-filler mixtures. A certain filler was found to necessitate the use of 2·85, 2·88 and 2·5 times the weight of another filler to produce mixtures of the same consistency as determined by the Furol viscometer, and float test and Miller and Traxler Asphalt Index methods respectively, and it is suggested that the latter method could be used as a Filler Stability Index by use of castor oil or a standardized asphaltic material. The bitumen required by the material passing the 200-mesh sieve can be determined with surface area methods by use of a variable coefficient based on the effect on viscosity of bitumen; this is termed the S. factor. A proposed specification for filler is given and methods of test for cementation value and S. factor are described.
A. O.

1168. Bitumen in Constructional Work. F. Joedicke. *Petr. Z.*, 28.7.37, **33** (30), 1–5.—The article consists of a summary of the occurrence, manufacture and handling of bitumen and natural asphalt, together with a brief description of the more important uses of these products in the form of bituminous paints, felts, impregnated paper, and road asphalt. Mention is made of the use of bituminous paints for the prevention of rust formation on ironwork of structures such as bridges, of the use of felt and impregnated paper for roofing and general moisture insulation, and of bitumen and natural asphalt in the various methods of road construction and surface dressing.
A. O.

1169. Study of Bituminous Materials and Weathering Tests. J. Zapta. *Proc., Jan.* 1937, *Technical Session U.S. Assocn. Asphalt Paving Technologists*, p. 85.—Preliminary data are presented on the results of tests carried out by the laboratory of the State Highway Commission of Wisconsin in order to assess the weather-resisting qualities of slow-cure road oils and cutbacks. The tests made included determination

of unsaturates on the bituminous material before and after exposure in a paint-weathering test apparatus. It had been noticed that the more oily-looking products after application changed in colour to a light brown, while the mix showed reduced cohesion and adhesion. To follow the changing composition of such oils, determinations were made of hard and soft asphalts, oily constituents and resins on the oils before and after the weathering test. As a guide to the evaluation of laboratory results, determinations were made on samples of bituminous mixes taken in the field at fortnightly intervals from mats built during 1936. C. L. G.

1170. Bituminous Paints. Anon. *Asphalt u. Teer*, 1937, **37** (24), 327–329.—The article deals with the use of bituminous paints in England and America for coating structural ironwork, both submerged and exposed to sea water, and exposed to air. Types of bitumen which are most suitable for paints of various kinds are described, together with the results which have been obtained when using such protective coatings. A. O.

1171. Spreading of Low-Cost Bituminous Resurfacing Mixtures. J. H. Goshorn. *Proc. Assoc. Asphalt Paving Tech.*, 1937, 30–38.—The paper describes two types of combined spreading and finishing equipment used for laying "hot-mixed, hot-laid asphalt mat surface" and a mixing and spreading machine for construction of "bituminous macadam surface course-special road mix." Details of the composition of the two types of surfacing are also given. A. O.

1172. Physical Changes in Aggregates in Bituminous Mixtures Under Compaction. M. F. Macnaughton. *Proc. Assoc. Asphalt Paving Tech.*, 1937, 7–23.—It is stated that whereas open mixtures depend on interlocking of angular stones for stability, the stability of dense mixtures is due largely to frictional resistance at the points of contact of the aggregate and the bitumen content should not exceed the void volume of the aggregate compacted to maximum density. Void determinations on the separately compacted dry aggregates are thought to be misleading and better results obtained by addition of bitumen or oil of suitable consistency, methods of compaction also do not duplicate the action of heavy traffic. The paper points out that in service the particles in a mixture are rearranged and pressed closer together with consequent grinding off of corners, increase in fine material, decrease in voids and possible development of instability owing to excess of bitumen. The Hubbard–Field extrusion method, and a modification, is used by the author for testing stability of sheet asphalt and asphaltic concrete, and the direct compaction method originally used for preparation of specimens was found to give mixtures of lower density than is obtained under traffic compaction, while increasing the load resulted in crushing of the aggregate, compaction in a mould with a 13-pound hammer operating at 2800 blows per minute under 70 pounds pressure for 5 minutes was therefore used. A comparison was made of the tendency of single sized aggregates to crush under direct compression and when compacted with the pneumatic hammer. The procedure consisted in compaction of the mixture of aggregate and bitumen, determination of density, extraction of bitumen and sieve analysis of the aggregate, this process being repeated until the maximum density was passed. Degradation occurred with both methods but was more severe under direct compaction. It is admitted that changes in aggregate structure are limited in practice but examination of a number of samples of bitumen pavement confirmed that changes do occur. Details and results of both investigations are given. A. O.

Detonation and Engines.

1173. Comparison of Octane Ratings made by Army and C.F.R. Methods. Anon. *Oil & Gas J.*, 24.6.37, **36** (6), 82.—Results of tests carried out on various types of fuel by F. D. Klein and R. V. Kerley are tabulated and graphed.

Results show that:

(1) Up to 80 Octane all fuels rate approx. equal by both methods of test.

(2) Cracked fuels diverge from the general curve showing higher ratings by the Army method.

(3) The Army method depreciates the antiknock ratings of benzol blends.

(4) Straight-run gasolines blended with *iso*-octane are generally rated higher by Army method.

(5) Natural gasoline and blends with straight-run gasoline and hydrogenated olefin polymers are rated approx. equal by both methods.

Conclusions (3), (4) and (5) apply particularly to fuels of over 80 Octane rating, many of which contained T.E.L. in addition.

Laboratories using the C.F.R. method have reported that fuels of approx. 100 Octane number are difficult to rate correctly by that method. R. A. E.

1174. Cetane Numbers—Life Size. R. F. Good. *J.S.A.E.*, 1937, **40**, 232–241.—This article gives a detailed account of an investigation undertaken by the U.S. Naval Engineering Experiment Station to establish a suitable specification for high-speed diesel fuel. More than 100 fuels were tested including practically every well-known type. Four engines were used and the duration of tests varied from 8 to over 100 hrs. The engines included the C.F.R.–A.S.T.M. Diesel Unit fitted for ignition quality ratings by four methods, but the only results reported are by the methods tentatively accepted by the Compression Engine Volunteer Group. All full-scale testing was done by a special single-cylinder unit rated at 75 B.H.P. at 750 r.p.m., delays being measured with a magnetic type two-element oscillograph. Details of these circuits and oscillograms from the apparatus are reproduced. The Author has experienced very good agreement between the Cetane No. on various engines and the "Computed Combustion Knock" first proposed by Joachim.

It is concluded that Cetane Nos. obtained in the laboratory using the knockmeter delay method in the C.F.R. engine provide a reliable forecast of the performance in the class of engine represented by the submarine test unit. The Critical Compression Method fails to correlate with service engines on abnormal fuels. Ignition quality indices derived from physical and chemical examination of the fuels give fair correlation with service engines for normal fuels, but are unreliable on doped fuels.

The Author favours an attempt to instrument the C.F.R. engine to compare fuels on combustion shock. C. H. S.

1175. High Output in Aircraft Engines. R. N. Du Bois and V. Cronstedt. *J.S.A.E.*, 1937, **40**, 225–231 and 262.—The use of very high Octane No. fuel is now rapidly becoming universal and the Authors show theoretically the effect of variables such as supercharger compression ratio and cylinder compression ratio, and calculated explosion pressures are given for various combinations. From an examination of these curves it is obvious that a specific power output may be obtained in several different ways. Results obtained with the N.A.C.A. Maximum Pressure Indicator show very good agreement with the calculated pressures, and various charts and curves are given which show how varying design alters the maximum output possible on various fuels. The Authors conclude that modern fuels have made possible outputs which the designer has not yet been able to use to advantage. It is suggested that the use of pressure inhibitors must be investigated. Study of spark-plugs with electrodes possessing varying degrees of electron emission is suggested as a possible means of controlling cyclic variations in maximum pressures. C. H. S.

Coal and Shale.

1176. Coal Liquefaction Research in the Imperial Japanese Navy. T. Yokota. *J. Fuel Soc. Japan*, 1937, **16** (177), 51.—A summary is given of the progress in the research on coal hydrogenation carried out by the Imperial Japanese Navy since 1921.

Following early experimental work in Japan on Sakito and Takashima coals, semi large-scale tests were carried out by the Bergius Laboratory in Germany on Shinbara coal, a yield of 30–35% of an oil resembling crude petroleum being obtained. Larger scale tests (3 tons *per diem*) on Fushun coal at 400° C. and 200 atmos. gave yields of 75·4% of oil of I.B.Pt. 86° C. and 34·6% distilling to 280° C.

Since 1934 experiments have been carried out to obtain figures necessary for the planning of a pilot plant as well as establishing the fundamental theories of coal liquefaction. It was found that increasing the temperature from 415° C. to 425° C.

increased the yield of oil from 68·2% to 70·6%, the oil obtained having a lower I.B.Pt. (55° C. as against 93° C.) and distilling 36·9% instead of 30·4% to 280° C.

The chemical composition of different fractions of the oil obtained is given graphically, it being shown that with increasing fractionating temperature the percentage of aromatic hydrocarbons increases rapidly while that of the naphthene hydrocarbons decreases rapidly, the sum of the two types remaining fairly constant (54–62%). Thus by rehydrogenating the high aromatic fractions over 180° C., oils rich in naphthene hydrocarbons can be obtained. From an examination of the chemical construction of the ring hydrocarbons and of the water and gases formed it was concluded that the chemical reactions required for liquefaction involved (1) deoxidation, (2) decomposition and (3) hydrogenation. Calculations of the heat of reaction based on the above chemical reactions gave figures of 642 and 942 cals. per gm. of net raw coal at reaction temperatures of 415° C. and 425° C., and 260 and 365 cals. per gram of overall raw materials. C. L. G.

Economics and Statistics.

1177. Liquefied Petroleum Gas Consumption—1936. Anon. *Petr. Eng.*, Midyear 1937, **8** (10), 45.—More than 106 million gallons of liquefied petroleum gases were consumed in the U.S. in 1936, as compared with the 1929 figure of 18 million gallons. Industries absorbed 54,585,000 gallons, more than half of which was butane. Liquefied gases were also used as raw material in the production of alcohol, acetone, solvents, anti-freeze preparations and other chemical products. Domestic consumption of bottled gas (largely propane) amounted to more than 30 million gallons. Gas companies used 9,371,000 gallons (two-thirds of which was butane) which was mixed with manufactured gas. 12,476,000 gallons (three-quarters of this being butane) were used as fuel for internal-combustion engines. C. L. G.

1178. Carbon Black Industry, 1936. Anon. *Petr. Eng.*, Midyear 1937, **8** (10), 28.—The U.S. carbon black production in 1936 reached 411,345,000 lb., an increase of 17% over that of 1935, the demand having increased in 1936 by 21%. Plant values rose by 0·02 c. per lb. to 3·92 c., while the export value remained at 4·69 c. per lb. 53 plants were in operation, 80% of the total production originating from the Texas Panhandle. 283,421 million c. ft. of natural gas were burnt to produce the carbon black, this figure representing about 13% of the estimated gas consumption in the U.S. The average yield was 1·45 lb. per 1000 c. ft. Of the domestic sales, 89% were consigned to rubber companies, 6% to ink companies and 2% to paint companies. Exports amounting to 154,718,398 lb. were made, largely to the U.K., France and Germany. C. L. G.

BOOK REVIEW AND BOOKS RECEIVED.

Book Review.

THE MECHANISM OF CONTACT CATALYSIS. R. H. Griffiths. Pp. xl + 208. London: Oxford University Press. Price 15*s*.

An increasing amount of work has been devoted to the subject of heterogeneous catalysis during recent years, and this literature has grown so vast that it has become more and more difficult to keep pace with it. Hence the need for such a survey as that which Dr. Griffiths has provided, giving in a reasonable compass a guide to an intricate mass of information on catalytic reactions at surfaces. The author's position as Senior Research Chemist with the Gas Light & Coke Company has given him first-hand experience of many industrial applications of catalysis, but he emphasizes throughout the necessity for fundamental treatment of this subject, and hence the monograph is not overloaded with technical details of, for example, the hydrogenation of carbonaceous material and the large-scale synthesis of methanol and ammonia.

The scope of this work is illustrated by the following divisions:

Experimental Methods;
Adsorption;
Promotors and Carriers;
Poisoning and Retardation;
Examination of the Catalyst Surface;
Geometry of the Catalyst Surface;
Mechanism of Catalysis and the
Development of Catalysts.

The text is well reinforced by experimental data, and very ample references are provided. The treatment is clear and concise, and altogether the book will be of particular service to the chemist in industry. A. E. D.

Books Received.

COMPREHENSIVE INDEX OF THE PUBLICATIONS OF THE AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS, 1917–1936. D. W. Heath. Pp. 382. American Association of Petroleum Geologists, Tulsa, Oklahoma, U.S.A., 1937.

The publications of the American Association of Petroleum Geologists during the first twenty years of its existence comprise twenty volumes of the *Bulletin*, and eleven special publications. A detailed index to these publications has now been collected within a single volume, comprising 382 two-columned pages of references. Subject and author index are combined. Double references are made to papers which were published both in the *Bulletin* and in one of the special volumes. Items based on titles of major articles in the *Bulletin* or of chapters of books are shown in bold-faced type which, in such a vast accumulation of references, is of considerable help to the searcher.

THE PENNSYLVANIA STATE COLLEGE BULLETIN. (ENGINEERING EXPERIMENT STATION SERIES. BULLETIN No. 46.) PENETRATION OF OIL SPRAYS. P. H. Schweitzer. Pp. 78. Figs. 54. Pennsylvania State College. Pennsylvania, 1937. 75 cents.

The Bulletin presents the latest as well as earlier results of extended studies on the penetration of sprays such as are used in Diesel engines, atomizers, paint sprayers, oil burners, etc., with primary regard to Diesel engines.

TESTING METHODS FOR PETROLEUM PRODUCTS. ENGLISH EDITION. Dr. E. Molnar and P. A. Graf. Pp. 184. Tables 13. Publication No. 7 of the Austrian Petroleum Institute. Verlag für Fachliterature Ges. m.b.h. 4, Vegagasse, Vienna XIX. 1937. £1.

The German edition of this book was reviewed in *J.I.P.T.*, 1937, **23** (163), 223A.

The English edition is now available, and contains a few improvements on the German original. In the preface the authors attempt to explain more clearly the

differentiation between National Standard Methods (N), Inofficial Standard Methods (R) and Other Testing Methods (V).

Canada Department of Mines and Resources:

ANALYSES OF COALS AND OTHER SOLID FUELS 1934–1936. J. H. H. Nicolls and C. B. Mohr. Pp. iii + 139. King's Printer, Ottawa. 1937. 25 cents.

The analyses are tabulated under the three following group headings: (1) Coals and other solid fuels occurring in Canada. These comprise a number of "mine" and a few "prospect" samples. (2) Coal samples submitted by the Department of Pensions and National Health. These include both Canadian and United States coals, and are all commercial samples consisting principally of "slack" coal. (3) Miscellaneous solid fuels. These consist of imported coals and a number of high-temperature cokes obtained from manufacturers. This group also includes some processed fuels, including petroleum and low-temperature cokes and various kinds of briquettes.

THE CANADIAN MINERAL INDUSTRY IN 1936. Staff of the Bureau of Mines. Pp. 78. King's Printer, Ottawa. 1937. 25 cents.

This pamphlet comprises statistical reviews of the metals, industrial minerals and fuels of Canada. The total production of petroleum in 1936 was 1,498,006 barrels, an increase of 3 per cent. over that of 1935. The chief production of natural gas and petroleum in Canada came, as in previous years, from Alberta.

PHOTOMICROGRAPHY WITH THE VICKERS PROJECTION MICROSCOPE. Pp. 64. Illustrated. Cooke, Troughton and Simms. Buckingham Works, York, England. 1937. Paper 5*s.*; cloth 6*s.*

This booklet gives detailed instructions regarding the operation of the Vickers Projection Microscope, Models 1 and 2. A chapter is devoted to the preparation of specimens and to the application of the instrument in steel-works practice.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, UNIVERSITY OF LONDON, CALENDAR 1937–1938. Pp. 573.

Part I contains such information concerning regulations, courses of study, scholarships, etc., as is necessary for intending students. Part II contains the terms of the College Charter, an historical account of the development of the College, lists of scholarship holders, prizewinners, diplomates, associates, etc.

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Geology.

1179. Geology of Western Minnesota: Traverse, Bigstone Counties. G. A. Theil. *Oil & Gas J.*, 19.8.37, **36** (14), 27.—The area is a level plain largely covered by glacial drift which varies in thickness up to 250 ft. The Pre-Cambrian is overlain unconformably by Cretaceous deposits which occur over most of the area. They attain a maximum thickness of 440 ft. and are represented by a thin basal sand overlain by a soft clayey shale. Oil and gas possibilities in this area are very unfavourable owing to the insufficient thickness of the sediments and lack of cover. Pockets of gas have been discovered locally, but they are under very low pressure and have no commercial value. J. A. G.

1180. New Natural Gas Pool Opened in Steuben Field, New York. J. P. O'Donnell. *Oil & Gas J.*, 12.8.37, **36** (13), 38–42.—A well near Woodhull, in Steuben Co., entered the Oriskany, and is now producing large quantities of gas. The structure is presumed to be a dome situated on the Van Etten Anticline, the latter being an extension of the Harrison Anticline. J. A. G.

1181. Friendswood Field has Three Factors Attracting Notice. F. L. Singleton. *Oil & Gas J.*, 12.8.37, **36** (13), 43.—The discovery well is located about 2½ miles north of the Hastings field in Texas, and is producing from the Frio Sand. The latter contains several shale bands, but at least 191 ft. of sand are known to be oil-saturated. Two dry holes have been drilled in the area, and it is believed that production is controlled by a N.W.–S.E. fault to the west of the discovery well.

It is probable that the structure is connected with the Genoa field which lies about 2½ miles to the north. There is no evidence that it is part of the Hastings structure. J. A. G.

1182. Permian Formations of the Pecos Valley of New Mexico and Texas. W. B. Lang. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 833–898.—Correlation of the Permian deposits of this area have been very difficult owing to the abrupt changes in lithology and in the colour of the rocks. An attempt is here made to clarify their relationships and to show the main causes of these variations.

Three geographic zones or provinces have been made: (1) the Delaware basin or fore-reef province, (2) the reef-zone, and (3) the back-reef province, all of which are continuous about the rim of the basin. The Permian sediments themselves have also been divided into three parts: the Lower represented by the Bone Spring limestone and Abo sandstone, the Middle or Delaware Mountain time unit, and the Upper or sequence of chemical precipitates. Detailed stratigraphic and lithologic descriptions of these beds are given. The main factor controlling the location and type of sedimentation was structural movement.

It would seem that throughout Permian times waters containing an unusually high content of mineral salts were present in some part of the basin, as all the chief horizons contain halite or anhydrite in places and are associated with reddish-coloured beds. A diagram is given showing the vertical continuity of saline basins in the Permian and the general horizontal S.W. movement of them in each formation.

Permian formations often change in colour as they alter in composition laterally. This variation may be accounted for by a transition from one area of deposition to another, and in the S. Permian basin this relationship is well shown. A table is furnished showing the dominant colour of beds and salinity of water in an epi-continental sea depositing saline sediments.

The greatest accumulation of the Permian sands appears to have occurred during Middle Permian times, when sandy deposits contained in the Delaware Mountain and Chalk Bluff formations were deposited contemporaneously in different areas. The possible source of the sands is thought to be Llanoria and Appalachia.

Concluding sections of the paper deal with reef structure and the subsequent geological history of the area as a whole. G. S. S.

1183. Developments in North-Central Texas and the Panhandle. A. W. Weeks. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 1015–1033.—In this paper only the more im-

portant new producing areas are mentioned. Production statistics, wells drilled, and, with the aid of generalized cross-sections, a general account of the regional geology are given. A few deep tests which have given rise to unusual interest are also discussed.

North Central Texas. Production in N. and W. Central Texas is mainly from rocks of Pennsylvanian age, and is controlled both by structural and stratigraphic traps.

The largest single unit of new production discovered and developed during 1936 was from lenticular Strawn Sands (at 2000 ft.) in the Anderson and Kerr field, S.E. of Gainesville, Cooke Co. This field is situated on an eastward-plunging structural nose on the N.E. flank of the Muenster arch. It covers about 550 acres, and is defined by 105 oil wells and 16 dry holes. A daily production of about 4000 brls. of 40° A.P.I. gravity oil is maintained.

Production and drilling statistics are then given, together with the chief wildcat tests and an account of the general activities.

Panhandle Oil- and Gas-field. This field is situated on the Amarillo uplift, and oil accumulation occurs in the "Panhandle Lime" and granite wash of the Lower Permian and Upper Pennsylvanian. Gas production is confined, in general, to the structurally higher part of the field.

A further extension of production occurs in the Stinnett area (West-Central Hutchinson Co.). Here ten oil wells have been completed and several tests are drilling.

New activities in the Panhandle field also include those in Moore Co., where the most important production is natural gas. A table of oil-production figures in the Panhandle district is furnished. G. S. S.

1184. Developments in West Texas and South-eastern New Mexico in 1936. H. P. Bybee and B. R. Haigh. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 1034–1041.—Developments during 1936 made a great advance in the combined area of W. Texas and S. New Mexico. Nine new pools were opened in W. Texas and three in New Mexico. Extension took place in five producing areas in New Mexico, and practically all fields in Andrews, Ector, Ward, and Winkler counties, Texas.

Though a very small number of wildcats were drilled as compared with the preceding year, field development was far greater, due doubtless to improved market conditions.

Results in statistical form are tabulated and brief references to extensions conclude the paper. G. S. S.

1185. Developments in South Texas District in 1936–1937. H. H. Nowlan. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 1042–1049.—This is a brief review of the developments in S. Texas from March 1936 to March 1937.

During the past three years the advance in knowledge of the area has been much greater than in the previous ten years. In the past year, for example, twenty-five new pools were discovered together with twenty-nine new productive sands and extensions; twenty-seven of these were in the Coastal zone, twenty-one in the Jackson, and six in the Fault Line zone. Some of the more important include the Flour Bluff field (Nueces Co.), Sweden field (Duval Co.), Heyser (Calhoun Co.), Lamar (Aransas Co.), La Blanca (Hidalgo Co.), Alta Verde and Alta Mesa fields (Brooks Co.), and La Sal Vieja (Willacy Co.).

It is anticipated that Flour Bluff and similar pools will produce from 20,000 to 50,000 brls. per acre from an average depth of 6000 ft.

Geophysical methods were much used, and were largely responsible for the discovery of several new fields in the Coastal area. G. S. S.

1186. Developments in North-east Texas District in 1936. W. Ralston. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 1063–1067.—1936 saw the discovery of two oilfields as a result of the drilling of seventy-seven exploratory wells. Three gas-distillate fields were also discovered (Grapeland, Shelbyville and Carthage), and these may prove to be substantial oil-producing fields.

The two new oilfields are Talco and Sulphur Bluff. Talco is a fault structure of the Mexia–Powell type, and is the first commercial production, from the Paluxy formation, in Texas. Sulphur Bluff is a similar structure to Talco, and has a proved area estimated at about 1500 acres. The oil produced is about 22° gravity, resembling that supplied at Talco. G. S. S.

1187. Developments in Arkansas–Louisiana–Texas Area, 1936–1937. D. H. Bingham. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 1068–1073.—During 1936 developments in N. Louisiana, N.E. Texas, and S. Arkansas were more active than in any year in the past decade.

The finding of prolific oil as well as gas reservoirs in the lower Glen Rose, the development of distillate production in the lower Trinity Marine at Cotton Valley (Louisiana), and the opening up of oil and gas production in the Smackover Limestone at Smackover, were probably the chief happenings.

Summaries are given of five new areas of oil production, six areas of important gas production, and the new distillate production area at Cotton Valley.

The most important extension, from an economic point of view, was that of the Rhodessa oil- and gas-field into Cass and Marion Cos., Texas. To February 1st, 1937, the Cass Co. side of the field had produced 4,324,886 brls., whilst the Louisiana side had produced 22,100,346 brls. The daily average production of the field is 87,554 brls.

G. S. S.

1188. Recent Developments in Kansas and Nebraska in 1936. M. Lee and G. W. Baughman. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 1000–1005.—This is a short summary of the activities and progress of development in Kansas and Nebraska in 1936. Brief reference is made to the types of exploration work, the geology, and production figures of the two States. New developments in Kansas include the Trapp field (Southern Russell Co.) which produced 400,000 brls. to December 31st, 1936.

G. S. S.

1189. Developments in Oklahoma in 1936. F. A. Bush. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 1006–1014.—In Oklahoma, during 1936, wildcat exploration was responsible for the discovery of eleven gas wells and twenty-three oil wells. Although most of them were of minor consequence, and no fields of great importance were opened, several notable extensions of fields previously discovered were largely developed, both geographically and vertically.

Much of the geological exploration was carried on by means of geophysical methods, and was mainly confined to S.E., E. and Central Oklahoma.

Production for the State was 200,880,705 brls., compared with 182,596,874 brls. in 1935. G. S. S.

1190. Gulf Coastal Developments in 1936. O. L. Brace. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 1050–1062.—Although 1936 furnished twenty-one new productive areas, probably none of these can be compared with the outstanding discoveries of 1935.

Two new fields were located along the Jackson trend in Polk Co. (Segno and Ace), and three in the intermediate zone (Silsbee, Fairbanks, and Clinton).

On the deep Coastal zone nine new productive areas were proved in Texas and seven in Louisiana. Geophysical prospecting played an important part in their discovery.

Much activity took place on old coastal domes during the year, economic productive horizons at depths of over 10,000 ft. being proved. It is considered that Coastal domes have immense future possibilities at greater depths than those that have so far been examined.

Although there are signs that the provision of first-class prospects are nearing an end, it is nevertheless thought that untested second- and third-class prospects—which are still available in large numbers—will supply new reserves of no less importance or value to those already developed. G. S. S.

1191. Upper Cretaceous of Rocky Mountain Area. J. G. Bartram. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 899–913.—The Upper Cretaceous series covers the greatest area and is the thickest of all deposits in the Rocky Mountain area. It is made up mainly of dark marine shales and sandstones, and, on the eastern edge, a few thin limestones. Although more work has been done and published on this than on any other series, much confusion and unnecessary duplication in the nomenclature exist.

The Upper Cretaceous sediments were eroded from a western area and washed and spread out over a great marine basin, the total area covered in the United States and

Canada exceeding 1,700,000 sq. miles. East of S.E. Idaho and N.E. Utah the beds are 8000–10,000 ft. thick, but throughout much of the Rocky Mountain area the marine basin was filled to a depth of 4000–5000 ft.

In the western part of the region the Upper Cretaceous can be divided into five sandstone units with four intervening shale bodies; the latter being given different names in different places. Brief descriptions are given of the sandstones, followed by a suggested grouping and classification of the shales.

The author concludes that the entire Upper Cretaceous series of the region should be reviewed, the present nomenclature revised and simplified, and a system of names chosen to fit genetic conditions and mappable lithologic units. G. S. S.

1192. Developments in Rocky Mountain Region in 1936. A. E. Brainerd and C. S. Lavington. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 986–999.—The discovery of two new oil horizons at 3085 and 5014 ft. in the Wasatch (Eocene) sediments of N.E. Colorado was the most important development of 1936 in the Rocky Mountain region. As a result of this discovery, a huge new area for prospecting is opened up in N.E. Colorado and S.W. Wyoming.

Of fluviatile origin, the Wasatch formation includes two sandstones constituting the Powder Wash anticline (Moffat Co.), a low fold between the Washakie and Sand Wash basins.

The possibility of two new black-oil fields in the Embar–Permian and Tensleep (Penns.) is indicated from the cores of deep tests on the Muskrat anticline in Fremont Co. (Wyoming). A further discovery in the Mosser dome, although of interest, is of doubtful commercial value.

On the Little Beaver dome of the Cedar Creek anticline heavy black oil has been found in the Madison (Mississippian) and Devonian (?) at 6747 and 8186 ft., respectively. Considerable interest is attached to this discovery, in that it encourages exploration of these horizons in adjoining States.

During the year several new outlets for crudes were made by new pipe-lines. Developments of this nature were carried out in the Lance Creek field (Wyoming), the Cut Bank area (Mon.), and in Colorado.

Both from an operating and exploratory standpoint, 1936 was a highly satisfactory year in the Rocky Mountain region as a whole. A table giving the summary of operations for the year concludes the paper. G. S. S.

1193. Discoveries in California in 1936. M. G. Edwards. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 977–985.—Discoveries of fields in California in 1936 exceeded in oil reserves those of any year since 1928, the year when the North Dome–Kettleman Hills and Elwood fields were discovered. Most of the important discoveries, moreover, were in Miocene rather than in Pliocene oil zones. Geophysical methods were used with success for the first time in California.

The new discoveries include the Terminal Well No. 1 (Wilmington field), the El Segundo No. 1 field, the Padre Canyon field, the Santa Maria Valley (Union Oil Company–Adam Well No. 1), and the Ten Section field (San Joaquin Valley).

In addition two new gas fields were discovered; viz. McDonald Island Well No. 1 and the Rio Vista field, both of which give production from sediments of Eocene age.

More activity is being shown in California at the present time in exploration work than has been evident for several years past. G. S. S.

1194. Saturation Percentages of Oil Sands. V. G. Gabriel and C. P. Dunbar. *Oil Weekly*, 9.8.37, **86** (9), 48.—Reasonably accurate knowledge of the percentages of oil saturation in oil-bearing formations is essential in the estimation and evaluation of oil properties and reservoirs.

Until recently very little has been published on the per cent. of oil saturation, as distinguished from porosity, and 100% saturation was often accepted without further investigation. This was due in part to the fact that a proper understanding of the difference between porosity and saturation was lacking, to a lack of proper technical methods of determination, and to an inability to obtain samples representative and unpolluted.

Percentage values obtained by the extraction method are always lower than those obtained by the retort method.

From the data given in one of the tables it is clear that careful and detailed analyses of core samples should be carried out. Calculations of the amounts of connate water and the relatively low saturation of oil sands should be based on a number of reliable determinations. L. V. W. C.

Geophysics.

1195. Progress of Geophysics. J. B. Eby. *Petr. Eng.*, Midyear 1937, **8** (10), 66–75.—The use of the reflection seismograph is still dominant, and the tendency is to construct smaller and lighter units. These, being more portable, are especially useful in marsh and swamp areas, and require smaller and fewer batteries. Timing errors have been reduced and the use of multiple seismometers is gaining in favour. Electrical filters are practically universal. Employing a spread of seismometers in continuous profiling has made it possible to follow certain individual reflections over many successive spreads, which would not be recognizable or usable with isolated shot locations.

It has become customary to place the charges at depths of 100–250 ft.

The shape of known salt domes is now being investigated by refraction seismology.

The seismic electrical effect defined by Blau and Statham is the subject of extensive research. The torsion balance has steadily increased in favour, and the use of the inclined beam has made it possible to obtain as many as eight observations in a day. Gravimeters have also been employed widely on the Gulf Coast. Several new methods of geophysical exploration are being investigated, amongst which is the examination of subsoil gases. G. D. H.

1196. Geophysical Results Spur to Further Exploration. N. Williams. *Oil & Gas J.*, 15.7.37, **36** (9), 36.–A number of oilfields in the Permian Basin of W. Texas and S.E. New Mexico can be attributed directly to geophysical work. Thirty crews are now operating there, of which seventeen are seismograph, six torsion balance, four gravitometer, two electrical and one magnetometer. Reflection shooting is most common, but two refraction crews are at work.

Hobbs, Monument, New Mexico and Means are amongst the fields found geophysically. Hobbs was drilled on the strength of a magnetometer survey checked by torsion balance. The other three were located by seismograph and torsion balance work.

The multiplicity of reflecting horizons which could not be correlated was an early obstacle. Dip shooting was tried, but not widely followed. More recently continuous profiling has been used with favourable results. The aim is to find truncations and overlapping in the Ordovician.

Costs in seismic work are almost twice as high as on the Gulf Coast. Shot holes range 100–200 ft. in depth owing to the thick surface deposit of caliche rock. In addition, the formations are hard. Three to five drilling rigs may be needed for each shooting crew against the usual one on the Gulf Coast. The scarcity of water has created a problem of loading the holes in some places.

High velocities characterize the shooting area. There is an unexplained absence of reflections in the Cretaceous areas around Big Lake and McCamey. Torsion-balance gravitometer and magnetometer results have at times been misleading due to regional features masking local structure. G. D. H.

Drilling.

1197. Recent Developments in Completing Wells Under Controlled Pressure. A. Pranger. *Oil Weekly*, 19.7.37, **86** (6), 48; *Petr. Eng.*, Aug. 1937, **8** (12), 24.—Drilling-in under controlled pressure is replacing the customary drilling-in method in many rotary areas. In highly permeable lime formations and low-pressure producing sands controlled pressure drilling is becoming the accepted practice. The method may use oil, a mixture of oil and gas and in some instances gas alone as a circulating column, depending on certain conditions existing in the well.

A series of diagrams is given showing hook-ups for drilling-in high-pressure wells and the method of drilling wells with flush joint or regular drill-pipe using friction kelly drive. L. V. W. C.

1198. South Texas Drilling Depths are Increasing. E. S. Post. *Oil Weekly*, 30.8.37, 86 (12), 62.—A definite trend towards deeper drilling has been evidenced in S. Texas during the past several months. Exploration of possible producing horizons to below 10,000 ft. has occurred, resulting in the increasing of new deep reserves and reasonable assurance that others will be revealed as the prospecting of deeper zones continues.
L. V. W. C.

1199. Test Borings in Lower Austria. Anon. *Petr. Z.*, 4.8.37, 33 (31), 12–13.—Test borings are made to provide data for structural interpretations and to test geophysical work. These are generally not more than 80 m. in depth, and so hand-boring is usually adopted. The type of apparatus in general use is briefly described. A short account of the present position of deep drilling in Austria is also given. S. E. C.

1200. Rotary Table Drive. C. F. Forsberg. *Petr. World* (L.A.), 1937, 34 (5), 57–63, 71.—It is claimed that, whilst considerable data has been gathered from time to time on electric power rigs, no attempt has apparently been made to segregate the table drive from the hoisting duty except in a most general manner. The paper reviews the facts obtained by running some tests on drilling rigs and finding the power requirements to operate the table with various weights on the bit. Horse-power output against table speeds, R.P.M. curves, illustrate the data obtained when drilling soft shale at 2600 ft. using 11-in., 12¼-in. and 14¾-in. drag bits. A similar chart illustrates the data obtained from tests with a 12¼-in. oscillating type bit at 1350 ft. hard formation, 2147 ft. tough shale, and 3030 ft. sticky shale. The paper concludes with a practical description of the conversion of the conventional rotary rig to direct drive, and with a summary of the advantages of this latter method. Photographs illustrate the equipment. T. C. G. T.

1201. Compactly Designed Portable Rig. Anon. *Oil Weekly*, 16.8.37, 86 (10), 36.—Portable rigs are now available which are capable of drilling to depths exceeding 4000 ft., but which weigh very little more than half the weight formerly thought necessary.

One rig of this type has drilled 150,762 ft. of hole since May 1935.

The rig consists of two main units, the drilling unit and the pump unit. Five truck loads are required to move from one location to another, not including the kelly and drill-pipe.

The drilling unit, mounted on one skid separate from the rotary table, includes a four-cylinder gasoline engine and the completely unitized draw-works. Six forward speeds are available on the drum and three on the rotary table.

The pump unit, mounted on one skid, includes a power slush pump and a six-cylinder gasoline engine. The drive is through a 3·75 reduction gear. L. V. W. C.

1202. Influence of Controlled Cement Slurry Weights in Squeeze Jobs. J. Barnes. *Petr. Eng.*, Aug. 1937, 8 (12), 30.—Squeeze jobs are used to shut off water or gas by forcing cement slurry under pressure into the formation, and although they have been recognized as valuable assets in protecting productive sands, little has been written on controlling the weight of the cement slurry and its influence on the degree of success of the job.

The weight of the slurry to be used is indicated by the permeability or by the pressure required to inject water into the formation. Where the pressure is high, a light slurry weighing about 12½ to 13 lb. per gal. should be used in order that the free water in the slurry may carry some of the finer particles of cement into the formation. Where the formation is very permeable or channelled a slurry of about 15 or 16 lb. per gal. should be used to ensure the cement being deposited uniformly on the face of the sand.

Where an indefinite amount of cement can be taken by the formation, the squeeze job may be successfully completed by allowing the cement to stand at rest for a while in the formation so that it will become unpumpable; then mixing a light-weight slurry and pumping it into the formation under increased pressure.
L. V. W. C.

1203. Curing Crooked Holes with Dynamite. F. R. Cozzens. *Oil Weekly*, 9.8.37, **86** (9), 17.—Dynamite bombs are being used by Ohio drillers to straighten crooked holes. Four cartridges of ammonia dynamite, 1¼ in. × 8 in., are lowered to the bad spot in the hole. A few feet of water, loose earth, or cinders are poured down upon the bomb as an anchor, and the pack is then fired electrically. The force of the explosion is insufficient to cause extensive caving, but is sufficient to crumble the sides of the hole and the debris that falls to the bottom of the hole makes a neat refill.

By this means the crooked section is entirely eliminated, and very rarely is a second bomb necessary. L. V. W. C.

1204. Using Automatic Feed and Weight Control at Hastings. B. Mills. *Oil Weekly*, 9.8.37, **86** (9), 44.—An automatic feed and weight control for rotary drilling is being tried in the Hastings field, Texas.

The control is an individual unit consisting of a V-8 engine driving a self-locking work gear through a variable-speed, reversible hydraulic transmission. A sprocket on the worm-gear shaft connects to the line shaft on the draw-works.

With the drum connected through the low clutch to the line shaft, the entire load of the drill-pipe is carried on the worm gear and handled by the V-8 engine.

Under conditions that require a constant weight, the driller, by manual control, sets the machine feeding at a rate that establishes the desired weight and then cuts in the automatic feature. The machine then automatically maintains the weight that was on the bit at the moment the switch was closed. L. V. W. C.

1205. Engineering Progress. E. S. Post. *Oil Weekly*, 30.8.37, **86** (12), 44.—The progress in both production and drilling engineering is exemplified by present-day S. Texas operating practices. Methods of development vary greatly and many of the S. Texas fields have become proving grounds for numerous theories.

The Ruston chalk has been revived by the use of acid and is now one of the major producing zones in certain areas. Previous to this practice the methods of recovery were so inadequate that the fields were looked upon as being non-commercial.

Abundant use of coring has brought to light many overlooked sand lenses and, due to improved treating practices, formations previously considered uncommercial are now paying their way. The elimination of gas wastage and the maintenance of pressures has increased the value of the property.

Through the adoption of new methods drilling has become deeper and faster. L. V. W. C.

1206. Patents on Drilling. A. C. Catland. U.S.P. 2,084,430, 22.6.37. Well reamer.

J. H. Howard and A. C. Catland. U.S.P. 2,084,442, 22.6.37. Rotary disc bit.

R. D. Brammon. U.S.P. 2,084,606, 22.6.37. An inside pipe cutter adapted to cut by rotation, means applied for effecting outward and inward movement of the cutters by a mandrel and means for gripping the pipe to be cut.

J. D. Brack. U.S.P. 2,084,988, 29.6.37. A pressure-operated core barrel.

O. R. Tautenhaln. U.S.P. 2,085,279, 29.6.37. A rotary reciprocating well drill having a fluid motor mounted on the rotary cutter and connected with the upper shank section to impart the reciprocating motion.

F. L. Scott and L. E. Garfield. U.S.P. 2,086,680, 2,086,681 and 2,086,682, 13.7.37. Drill cutter mounting and pilot bearing.

D. W. Lee. U.S.P. 2,087,155, 13.7.37. Combination portable tubing board and tubing rack.

T. W. Pew. U.S.P. 2,087,297, 20.7.37. A method of shutting off water sands from an oil and gas well, including filling the well with mud, introducing water into the lower end, forcing this water under pressure into the water sand only and washing the sand, and pumping fluid cement under pressure into the washed water sand.

A. C. Catland. U.S.P. 2,087,500 and 2,087,501, 20.7.37. Roller bit construction.

J. E. Brazell. U.S.P. 2,087,590, 20.7.37. Sand pump.

W. E. King. U.S.P. 2,088,418, 27.7.37. Hydraulic well swivel.

D. A. Glover. U.S.P. 2,088,514, 27.7.37. Escape device for derricks.

C. I. Stokenbury. U.S.P. 2,088,539, 27.7.37. A method of orienting a deflecting tool into a well. L. V. W. C.

Production.

1207. Kettleman Hills Well Attains New Record Production Depth for California. W. A. Sawdon. *Petr. Eng.*, Aug. 1937, **8** (12), 27.—The deepest commercial oil production yet found in California has been tapped by a Kettleman North Dome Association well. This well has reached a depth of 10,753 ft., and the initial production was 1172 brls. per day with 20,000,000 cub. ft. of gas. The flowing pressure was 2750 lb. per sq. in. L. V. W. C.

1208. Nomograph for Estimating Future Production of Oilfields in Volumetric Control. L. V. W. Clark and C. S. Newey. *Petr. Eng.*, Aug. 1937, **8** (12), 32.—The formula used in the construction of this nomograph depends on certain assumptions relating to rates of flow in the reservoir, the status of the producing wells, the extent of the structure as compared with the actual producing area and the type of producing sand.

Two examples are given and the results obtained are consistent.

Besides giving consistently good results, this method of estimating future production has the advantage over other methods and production charts of a theoretical basis in the reservoir itself.

Failure of the method may be explained by four factors which are given. L. V. W. C.

1209. Bradford Water-Flooding Principles Provide Value by Reviewing Basic Operations. Part I. J. C. Albright. *Oil Weekly*, 23.8.37, **86** (11), 41.—A review of the water-flooding history and practices at Bradford is interesting in view of the attention being paid to this method of production by operators in the Mid-Continent area.

The production curve of the Bradford area shows how successful the project has been there, but the full possibilities of this secondary recovery method are not yet known. Experiments continue to be conducted and advancements are constantly forthcoming.

Greater recovery of the residual oil from the sands at Bradford is hoped for as a result of the introduction of varying amounts of natural gas to the input wells before water is injected. This project has not been applied for a sufficient period to determine whether the practice will be the means of additional recovery or a hindrance to future production.

Four important factors must be considered before attempting to place any property under flood. These are: (1) a reasonable amount of residue oil in the formation, (2) uniform sand body, (3) suitable permeability, and (4) water of good quality in adequate quantities. L. V. W. C.

1210. Discussion on Repressuring. H. M. Ryder. *Oil Weekly*, 23.8.37, **86** (11), 32.—This article consists of an examination of repressuring in the form of questions and answers. Various aspects of this secondary recovery operation are considered, and the form of the answers gives the solutions to many of the problems which arise. L. V. W. C.

1211. Analysis of Sucker Rod Down-time Causes at Oklahoma City. T. B. Campbell. *Oil Weekly*, 9.8.37, **86** (9), 18.—Several important conclusions have been reached from a study of sucker-rod down-time records in the Oklahoma City field.

The standard string of rods in this field is a tapered one. In each case the string has been so designed that the maximum unit stress developed is equal in the different portions. Double-pin rods are used exclusively.

The most common break occurs in the body. In tapered strings using $\frac{3}{4}$ in. and $\frac{7}{8}$ in. a large number of breaks have been concentrated in a 1000-ft. section of the $\frac{3}{4}$-in. rods, and these failures have not occurred at the top of the section where the load is heaviest. It is probable, therefore, that the $\frac{3}{4}$-in. rods are being subjected to extra bending and vibratory stresses due to a flexing and compressing of the rods on the down stroke.

The best service can be had when the working stresses are kept below 30,000 lb. per sq. in.

The body break is nearly always about 6 in. from the upset, and it is believed by some that this type of failure can be remedied by the rod manufacturers designing a rod stronger at this point.

Pin breaks are generally due to poor make-up of the box and pin. Any looseness allows a lateral motion of the box with respect to the pin. Rod boxes very seldom fail.

Rods will in the future be chosen for individual wells, and studies will be concentrated on individual well conditions. L. V. W. C.

1212. Plug-Back and Reconditioning Work in the Talco District. M. Tucker. *Oil & Gas J.*, 1.7.37, **36** (7), 30.—Several interesting plug-back and well-conditioning jobs are being carried out in the Talco field.

This reconditioning plug-back work is for the purpose of cutting off a bottom oil sand which has not afforded profitable production.

There are two types of improperly completed wells in the field: first, those which have casing set on top of the sand, and have been drilled through both oil-producing levels, and secondly, those which have casing set on bottom with perforations in both the upper and lower sand levels. The first types are corrected by setting short strings and then perforating at the desired level or levels. The second group are reconditioned by setting a cement plug under high pressure back into the oil and water sand and in the pipe below the cement retainer which is set between the two points of perforation. L. V. W. C.

1213. Floating Sand, Corrosion, Crooked Holes and Use of Vacuum are Pumping Problems in Arkansas Fields. W. P. Johnston. *Oil Weekly*, 16.8.37, **86** (10), 30.—The greatest problem in the stripper wells in Arkansas is floating sand which is of too small a grain structure to be excluded by any form of screen which will not at the same time seal off the oil. All known forms of screen have been tried, but generally with poor results. The screen most favoured is a plain perforated liner with $\frac{3}{16}$- or $\frac{1}{4}$-in. holes spaced on 3-in. centres.

This sand trouble is aggravated by the application of vacuum to the casing-head. The producing sand is so porous that vacuum pulls through from one well to another, creating what is known locally as underground vacuum.

Tubing jobs are frequent, and the entry of air whilst pulling is taking place forces the level downwards and the sand against the walls, plastering up the formation.

Oil savers are used throughout the field to exclude the air whilst pulling and running the sand pump. L. V. W. C.

1214. Production Patents. C. C. Crickmer. U.S.P. 2,084,611, 22.6.37. Well packer.

J. C. Karcher. U.S.P. 2,085,664, 29.6.37. A method for determining the porosity of sub-surface rock formations, which consists in causing a current to flow through an insulated conductor inside the drill stem to a bit insulated from the stem and in measuring the amount of electrical polarization resulting therefrom.

E. P. Halliburton. U.S.P. 2,085,972, 6.7.37. Apparatus for testing oil well formations by pumping.

J. M. Levier. U.S.P. 2,085,986, 6.7.37. A deep well turbine pump.

J. T. Phipps. U.S.P. 2,085,997, 6.7.37. Well packer.

J. C. Emery. U.S.P. 2,086,409, 6.7.37. An oil well plugging device.

A. J. Penick and K. T. Penick. U.S.P. 2,086,431, 6.7.37. Tubing head.

A. Hollander. U.S.P. 2,086,806, 13.7.37. A multi-stage deep well centrifugal pump.

E. H. Cox. U.S.P. 2,086,935, 13.7.37. A well-testing device.

C. E. Van Stone. U.S.P. 2,087,174. 13.7.37. A pump polished rod attachment including a gripping device for the rod, a suspension head for attachment to the pump beam, and turnable and lockable means in the head.

H. C. Otis. U.S.P. 2,087,528, 20.7.37. A well seal.

P. Cavins. U.S.P. 2,088,151, 27.7.37. Hydraulically-operated clean-out tool having a sand chamber at the lower end and an air chamber above. A passage connects the two chambers, controlled by a valve. L. V. W. C.

Gas.

1215. Patents on Gas. Ruhrchemie A.-G. E.P. 467,032, 7.6.37. Separation of ethylene from coke-oven gas containing ethylene, propylene, propane, etc., by liquefaction. The ethylene is condensed with aromatics, *e.g.* benzene to produce ethyl benzene.

Ges. Für Linde's Eismaschinen A.-G. E.P. 468,614, 8.7.37. Separation of acetylene from mixtures of ethylene and ethane by rectification.

Ruhrchemie A.-G. E.P. 468,729, 6.7.37. Conversion of methane, ethane, or ethylene into acetylene. W. S. E. C.

Crude Petroleum.

1216. Present State of our Knowledge on the Origin of Petroleum. C. D. Nenitzescu. *J.I.P.T.*, 1937, **23**, 469–482.—A general discussion on the origin of petroleum with a selection of the more important experimental observations on the aspect of this comprehensive problem. Twenty references. G. R. N.

1217. Extent and Origin of Petroleum in Poland. S. Olszewski. *Petr. Z.*, 1.7.37, **33** (26), 1–8; 4.8.37, **33** (31), 1–11.—The first part of this paper is devoted to discussions on the constitution and properties of crude oils and natural gases, types of oil shows and their significance, various theories of the migration of oil, and inorganic and organic theories of the origin of oil. Pfaff's theory of migration is accepted, in which he postulates movement up cracks and fissures. From the point of view of origin, the need for large quantities of organic matter in the source-rocks is emphasized. Marine flora and fauna will supply this need, and the importance of fæcal matter should not be overlooked. Generation of petroleum commences as soon as this organic matter is embedded under anærobic conditions and sinking begins. Very favourable conditions were present in the Podolian and Gotlandian Upper Silurian, and in most cases it is in the Silurian that the source-rocks are to be found.

The Polish oil occurrences are divided into six zones. The first is the present productive area along the marginal zone of the Carpathians. A Silurian origin is suggested for most of this oil. The Podolian Silurian is considered to extend under the productive area, and migration took place up N.–S. dislocations. The second zone lies to the east of the E. boundary of the Polish Carpathians, between the Dneister and the Pruth. This has not been developed, but gas shows are numerous, the gas in one case containing 20% ethane, and drops of oil were found in Upper Silurian Orthoceras shells. In the third zone, which lies in Wolhynia and Polesia, shows of oil have been found in a shallow well and in the valley of the Horyn. Basaltic intrusions occur in this area, and it is considered that the oil migrated from the Silurian up through cracks caused by the intrusions. Numerous and good shows occur in the fourth zone in the N.W. Provinces. These are enumerated and references given. Conditions there may be similar to those in N.W. Germany, and in both cases a Silurian origin for the oil is suggested. The fifth zone is in Kielce, where shows of various types are found in the

Devonian, Permian, Jurassic and Cretaceous. The Upper Silurian appears to be absent in this area, and the source of the oil is sought in the Devonian. The sixth zone lies to the west of the Ropa. The crude in this zone is different from that found east of the river, and a mid-Devonian age is assigned to it.

Finally, problems involved in the genesis of dry gas, ozokerite and the bituminous Menelite shales are discussed. Dry gas is associated with coal deposits, not oil, and from the evidence of coal fragments in the Flysch, etc., it is suggested that the area around Daszawa and Kalusz was covered by a large coal deposit. After catastrophic sinking to great depths the associated gas rose and formed pockets. Ozokerite is the wax remaining after escape of large quantities of paraffinous crude during a cold period. The asphaltic Menelite shales are probably due to an escape of asphaltic crude which spread over the surface and impregnated the surface deposits. S. E. C.

1218. Evolution of Gulf Coast Crude Oil. D. C. Barton. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 914–946.—This paper is a continuation of Barton's earlier work on the natural history of Gulf Coast crude. The variation of the following factors with depth and age is discussed: percentage content of the various fractions of a crude, A.P.I. gravity of those fractions, change of base of crude, and variation of sulphur and carbon contents. To simplify the work, the crudes are divided into two groups: those from 3000 to 5000 ft., and those from 5000 to 7000 ft. It is found that oils of one age from the shallow zone are most like the next younger oils of the deep zone.

From a study of the data provided, the following points relating to Gulf Coast crudes emerge. As a general rule there is no upward migration from deep source-rocks into shallower reservoirs. Increase in specific gravity of a crude with decreasing depth is not due to evaporation of the light constituents, neither is it due to the effect of chemical reaction with the oxygen and sulphates of the surface waters. Observations point to the evolution of Gulf Coast crudes from a heavy naphthenic oil which, with increasing age and depth of burial, tends to become more and more of a paraffinic type. This involves a decrease in the carbon–hydrogen ratio of the crude. Such a decrease might result from a loss of carbon as CO or CO_2, but it is considered more probable that the hydrogen content is increased by methanation. It is pointed out that this is probably only an approximate statement of a more complicated law. S. E. C.

1219. Patents on Crude Oil. M. de Groote. U.S.P. 2,086,315–2,086,217, 6.7.38, A. M. Herbsman. U.S.P. 2,087,936, 27.7.37. Breaking petroleum emulsions of the water-in-oil type.

F. M. Clark. U.S.P. 2,088,406, 27.7.37. Refining of crude mineral oil for electrical application using a mixture containing 85% of concentrated H_2SO_4 and 15% of H_3PO_4 (85% strength) and applying 5 lb. of the acid mixture to 55 gallons of oil.
W. S. E. C.

Cracking.

1220. Patents on Cracking. Alco Products Inc. and C. E. Every-Clayton. E.P. 468,432, 30.6.37. Conversion of petroleum gases containing mainly C_1, C_2 and C_4 hydrocarbons into liquid aromatic and other cyclic hydrocarbons, *e.g.* naphthenes.
W. S. E. C.

Hydrogenation.

1221. Patents on Hydrogenation. H. E. Potts. E.P. 467,117, 11.6.37. Hydrogenation of carbonaceous substances at 380–500° C. and under 100–1000 atm. pressure, using as catalyst molybdenum and/or molybdenum compounds which have been impregnated with a HNO_3–H_2SO_4 mixture.

H. E. Potts. E.P. 467,853, 24.6.37, and E.P. 469,735, 29.7.37. Improved hydrogenation apparatus.

F. Uhde. E.P. 468,680, 30.6.37. Production of bituminous products from solid carbonaceous substances by hydrogenation in the presence of suitable pasting agents.

G. W. Johnson. E.P. 468,709, 12.7.37. Improvement in gas circulation in hydrogenation processes.

Ruhrchemie A.-G. E.P. 469,044, 19.7.37. Production of anti-knock fuel by treating hydrocarbons rich in H_2 (obtained by hydrogenation of CO at atmospheric or under slightly increased pressure) with those poor in H_2 (bituminous products).

G. W. Johnson. E.P. 469,048, 19.7.37. Destructive hydrogenation of carbonaceous substances to produce diesel and fuel oils.

G. W. Johnson. E.P. 469,158, 20.7.37. Destructive hydrogenation of asphaltic substances at 400–485° C. and under 50–500 atm. pressure, using 0·01–10% of an organic halide or NH_4Cl.

M. Pier, W. Simon and W. Kroenig. U.S.P. 2,087,608, 20.7.37. Hydrogenation of carbonaceous substances at 380–550° C. and under 50 atm. pressure using nickel iodide and molybdenum sulphide as catalysts.

T. W. Pfirrmann. U.S.P. 2,088,214, 27.7.37. Hydrogenation of carbonaceous substances, to produce lower boiling oils, using as catalyst an unsintered spongy iron product formed by reducing iron oxide. W. S. E. C.

Refining and Refinery Plant.

1222. Materials for Refinery Pumps and Compressors. J. W. Foster. *Refiner*, 1937, **16** (4), 152.—Practically all metallic pump materials originate in the form of castings or bar stock, the former being subdivided into ferrous and non-ferrous groups. Among the ferrous materials, unalloyed grey cast iron and "semi-steel have a wide application for general service centrifugal pump, casings, impellers and other internal castings. A rather widely used cast iron for refinery pumps is Ni Resist, which, besides nickel, contains manganese, copper and chromium. The use of stainless steel castings is, of course, widespread, but their employment depends on local conditions, and is often dictated by balancing the life of a material with its replacement cost. The non-ferrous group, particularly brass, bronze and monel metal, are used in conventional centrifugal pumps supplied for pumping water, gasoline, etc. Bar stock is used for shaft and bolting materials, and in the latter connection chrome tungsten and chrome molybdenum steels are frequently employed. Balancing sleeves, shaft sleeves and bushings must have exceptional wearing properties, so are generally made from Nitralloy, Stellite or hardened stainless steels. G. R. N.

1223. Packing Materials for Fractional Distillation Columns. C. O. Tongberg, S. Lawroski and M. R. Fenske. *Ind. Eng. Chem.*, 1937, **29** (8), 957.—A helical wire packing of a type previously described by Fenske and co-workers, but of considerably smaller diameter ($\frac{2}{32}$ in. i.d.) was tested in two columns 20 mm. i.d., one 23·5 in. long, and the other 111 in. Tests were at total reflux, using *n*-heptane–methylcyclohexane mixtures. The boiling rate was varied between 400 and 1100 c.c. per hour, the latter approaching flooding. The important fact was noted that the highest efficiency of the packing could be obtained only by deliberately flooding the column at the beginning of each test. If the column was dried and then the test made, the H.E.T.P. lay between 2 and 3 in. After flooding it fell to consistent values of 1 to 1·4 in. for the shorter column and 1 to 1·3 in. for the longer. P. D.

1224. Improving the Absorption Plant Cycle with Direct Fired Heat. E. G. Ragatz and D. E. McFaddin. *Petr. World* (L.A.), 1937, **34** (5), 73–83.—The utilization of direct-fired heat for the operation of absorption plant distillation equipment has been the object of much speculation in recent years. The Union Oil Co. has been successfully operating such a system at its Dominguez absorption plant for the past year, and this paper is a detailed analysis of that particular equipment and its operation. The paper is illustrated with flow charts, tables of operation details, and with photographs.

It is concluded that

1. A continuous or semi-continuous oil-conditioning unit is absolutely essential to the satisfactory operation of a direct-fired heater in absorption plant service.

2. Given a proper quality of absorption oil, no spare unit need be provided for a properly designed heater equipped with adequate safeguards against feed pump failure.

3. Stripping steam should continue to be used at the main stripping column.

4. The proper location for the fired heater is on a re-circulated side stream drawn off the main column two or three trays below the feed-plate.

5. The advantages of utilizing stripping steam in the main distillation column can be obtained without resorting to the continuous operation of an auxiliary boiler by the injection of a stream of water into a re-circulated portion of the column bottom.

6. A direct-fired heater installation is attractive both from an initial investment standpoint and daily operating savings, when the overall plant heat load exceeds 10,000,000 B.T.U. per hour.

7. The installation of a fixed gas fractionator in a low-pressure plant appears definitely justified if the plant is re-circulating sufficient fixed gases, whilst operating on a normal butane loss ratio of 10% or above at the absorbers. T. C. G. T.

1225. Need for Modern Plants Faces Refiner. R. Russell. *Petr. World* (L.A.), 1937, **34** (5), 38–40.—The improved stability of the market is an added incentive to both the major companies and the independents to construct new cracking and polymerization units for the production of high quality products. The article briefly surveys the general trend of these developments, and points out that the independent refiners are attempting to create their own crude supplies in order to ensure the regular operation of these expensive new plants.

The necessity for the use of high-grade alloys in the new plants is emphasized and a few methods of combating corrosion in existing plants are outlined. One refiner is treating his charge oil with lime, and it is claimed that no detrimental effects have been noticed in the characteristics of the fuel oil as regards basic sediment.

T. C. G. T.

Corrosion.

1226. Corrosion Resistant Stainless Steels. J. H. Critchett. *Refiner*, 1937, **16** (4), 156.—Plain chrome steels may be roughly divided into classes containing 1, 5, 8, 12, 18, 25, and 35% chromium. Their chemical resistance is a direct non-linear function of the chromium content with abrupt changes in the resistance curve after 11% and 22% for strong oxidizing agents. The nickel chrome steels are generally more resistant to the moderate oxidizing agents, the resistance increasing with the total alloy content, the range being 10–30% chromium and 8–35% nickel. The chrome manganese (18 : 8) steels are more resistant than the nickel chrome steels for certain corrosion media, *e.g.* sulphurous gases or hydrogen sulphide. The addition of other metals such as molybdenum, copper, tungsten, vanadium, etc., to the above stainless steels has proved of value in specific purposes, either by further increasing the corrosion resistance or by improving the workability without impairing its resistance. G. R. N.

1227. Vanadium Steels. J. Strauss and A. W. Demmler. *Refiner*, 1937, **16** (4), 161.—Low alloy addition vanadium steels are recommended for welded or forged high-pressure vessels operating at moderately elevated temperatures and for vessels operating at very low temperatures, *e.g.* below 0° F. Vanadium steels have been satisfactorily applied where rod wear may be severe, and in the manufacture of valves which are required to withstand severe corrosion. G. R. N.

1228. Aluminium Alloy Steels for Sour Crude Refining. M. Fleischmann and S. D. Williams. *Nat. Petr. News*, 28.7.37, **29** (30), R. 51.—A new chromium–molybdenum–silicon–aluminium steel has behaved very well in test service. After five years in a heat exchanger, tubes are still in excellent condition. As compared with 4/6% chromium–molybdenum steel, the new alloy has shown twice the corrosion resistance during 10,000 hours' service in a cracking furnace working at 925° F. and 425 lb.

pressure on a very sour crude. The corrosion that has occurred is very uniform over the whole length of the tubes. The aluminium reduces air-hardening and possibly work-hardening in the alloy, factors which probably explain the absence of differential corrosion. H. G.

Chemistry and Physics of Petroleum.

1229. Organic Reactions with Boron Fluoride. XIII. Alkylation of Benzene with Alcohols. J. F. McKenna and F. J. Sowa. *J.A.C.S.*, 1937, **59**, 470–471.—This paper describes the reaction of benzene with various alcohols in the presence of boron fluoride. The alcohols used have been normal and iso as well as secondary and tertiary alcohols. Normal and secondary alcohols give identical products, *e.g.* *n*-butyl and *sec.*-butyl alcohol both yielded *sec.*-butylbenzene derivatives. Similarly *iso*- and *tert.*-alcohols give identical alkylation products.

The mechanism of the reaction is thought to be that the alcohol is first dehydrated to an unsaturated compound with subsequent condensation of the olefin with the benzene.

The ease of the reaction depends on the ease of dehydration of the alcohol and, in general, boron fluoride gives different dialkylbenzenes as the main product than does aluminium chloride, when the latter is used as an alkylating agent.

The reaction in some cases is carried out at room temperature, and in others a temperature of 60° C. is necessary. W. E. J. B.

1230. Organic Reactions with Boron Fluoride. XV. Alkylation of Benzene with Esters. J. F. McKenna and F. J. Sowa. *J.A.C.S.*, 1937, **59**, 1204–1205.—It is possible to alkylate benzene using various esters both organic and inorganic, in the presence of boron fluoride. Normal and secondary butyl esters both gave secondary substituted benzenes, while an *iso*-butyl ester gave *tert.*-butylbenzenes.

The mechanism of the reaction appears to be similar to that found in the preceding paper—namely, intermediate olefin formation from the ester with subsequent condensation of the olefin with the benzene nucleus.

The boron fluoride may give a co-ordination compound with the oxygen of the ester, which apparently weakens the carbon to oxygen linkage and results in olefin formation.

The yield of alkylated benzenes is directly proportional to the quantity of boron fluoride used. The yield is increased with the time of heating.

As in the experiments with alcohols, the di-substituted benzenes, when formed, consisted mainly of *para*-derivatives with very small quantities of the *ortho*-isomers. W. E. J. B.

1231. Polymerization of Terpenes. M. A. Carmody and W. H. Carmody. *J.A.C.S.*, 1937, **59**, 1312.—This article describes experiments conducted to investigate the polymerization of terpene hydrocarbons by means of aluminium chloride in the presence of aromatics.

The experiments were carried out at 10–15° C., and the results obtained indicated that the aromatic hydrocarbons, *e.g.* toluene, benzene or xylene could be recovered at the end of the reaction in essential 100% yield. Additionally, the sum of polymeric products and unreacted matter did not exceed the weight of terpene undergoing polymerisation; thus under the conditions of the experiments the polymerization occurred without inter-reaction of terpene and aromatic hydrocarbons. W. E. J. B.

1232. Preparation of Di-Alkyl Acetylenes in Liquid Ammonia. E. A. Bried and G. F. Hennion. *J.A.C.S.*, 1937, **59**, 1310–1311.—This article describes a convenient method for the preparation of dialkylacetylenes. The process involves the interaction of sodium acetylide, sodamide and alkyl halides in liquid ammonia, in the approximate molar ratio of about 1 : 1 : 2.

Intermediate products are not isolated, and a substantial saving in time is effected as compared with older methods.

The following dialkylacetylenes have been prepared and their constants tabulated, diethyl, dipropyl, dibutyl, diamyl and ethylbutyl.

At atmospheric pressure the alkyl bromides were found to be the most suitable halides. W. E. J. B.

1233. Activity of Oxygen Towards Hydrocarbon Mixtures with a High Molecular Weight. H. I. Waterman, J. J. Leendertse and E. C. H. Palm. *J.I.P.T.*, 1937, **22**, 483–490.—About eighty hydrocarbon mixtures comprised of gas oils and lub. oils, both fully and partly saturated, were examined for sludge value by the Sligh oxidation test. These values were correlated qualitatively with the "ring compositions" of the samples. G. R. N.

1234. Catalytic Interaction of Heavy Hydrogen and Benzene on Platinum. A. Farkas and L. Farkas. *Trans. Faraday Soc.*, 1937, **33** (7), 827.—The catalytic interaction of heavy hydrogen and benzene on a platinum foil at room temperature and at different partial pressures of hydrogen and benzene varying from 3 to 150 mm. of Hg, leads to the occurrence of two reactions: (*a*) exchange of hydrogen atoms between benzene and gaseous hydrogen, (*b*) hydrogenation of benzene. These two reactions are independent of each other. In the gaseous phase the absolute rate of the exchange is independent of the hydrogen pressure and approximately proportional to the 0·4th power of the benzene pressure, whilst the absolute rate of the hydrogenation is proportional to the hydrogen pressure and practically independent of the benzene pressure. The two reactions have been compared with each other in the gaseous and liquid phase, and with the speed of the conversion of *para*-hydrogen, the catalyst being in contact with gaseous and liquid benzene. In the gaseous phase the conversion is much faster than the exchange, whilst in the liquid phase the rate of both is approximately the same. The rates of hydrogenation are smaller in the liquid phase than in the gaseous phase.

In the gaseous phase the catalyst surface is covered with hydrogen and the benzene molecules occupy only a certain few places which absorb them strongly. In the liquid phase the catalyst is covered with a film of benzene which displaces hydrogen. The hydrogenation and exchange proceed according to different reactions; the hydrogenation involving a simultaneous addition of two hydrogen atoms, whereas the exchange consists of the dissociation of the benzene molecule into a phenyl radicle and a hydrogen atom followed by the reunion of the phenyl radicle with another hydrogen atom from the absorption layer. H. E. T.

1235. Mechanism of Hydrogenation Reactions and the Formation of Stereochemical Isomers. A. Farkas and L. Farkas. *Trans. Faraday Soc.*, 1937, **33** (7), 837.—In the catalytic hydrogenation of unsaturated compounds it is suggested that both hydrogen atoms of the same molecule are simultaneously added, in contrast to the addition of nascent hydrogen, which involves the consecutive addition of two independent atoms. According to this mechanism, it is shown that the catalytic hydrogenation of acetylene compounds and of *cis*- and *trans*-ethylene derivatives should lead to the formation of *cis*-ethylene compounds, *meso*- and racemic compounds, respectively, and the addition of nascent hydrogen to the thermodynamically stable stereo-isomers. The *trans*- and *meso*-compounds are usually the stable hydrocarbons. Apparent exceptions to this mechanism may be accounted for by the catalytic conversion of the primarily formed unstable compounds into the thermodynamically stable ones. From experiments on the catalytic exchange of hydrogen atoms between gaseous hydrogen and organic compounds, it is shown that such catalytic conversion reactions occur only with di-substituted ethylene derivatives and compounds containing the CO group. A close similarity exists between halogenation reactions and the addition of nascent hydrogen as far as formation of the stereo-isomers is concerned. H. E. T.

1236. Hydrogenation of Nickel Carbonyl. E. E. Litkenhous and C. A. Mann. *Ind. Eng. Chem.*, 1937, **29** (8), 934.—The hydrogenation reactions of nickel carbonyl have been examined over the temperature range 25–400° C. and from 1 to 75 atm. pressure. A dynamic pressure hydrogenation apparatus was employed, and in every experiment the molecular ratio of hydrogen to nickel carbonyl was maintained at four to one, and the molecular ratio of carbon monoxide to hydrogen was one to one. The initial gas rate of flow was regulated at 7·26 c.c./minute at standard temperature and pressure.

The products of the reaction were carbon dioxide, methane and water. The mechanism of the reaction depends on the formation of water and the subsequent reaction according to the equation

$$2C + 2H_2O = CO_2 + CH_4$$

This equation gave constant values for $\log_{10}K$ over the whole reaction range, whereas the other equations quoted did not. In the hydrogenation of nickel carbonyl at 250° C. almost 60% of the reaction product was water, and after this water was formed it reacted according to the above equation. The element carbon is quite unreactive to water at 250° C., but in the presence of nickel the carbon was activated sufficiently to react with water. In all, thirteen possible reactions are quoted and at temperatures above 250° C., general equilibrium between all of these reactions. The values of $\log_{10}K$ for these reactions were constant at constant temperature above 250° C., and agreed within experimental error with the results obtained by previous investigators.

H. E. T.

1237. Primary Liquefaction of Coal by Hydrogenation. C. H. Fischer and A. Fischer. *Ind. Eng. Chem.*, 1937, **29** (8), 939.—The work described in this report was carried out in order to obtain information on the relative effectiveness of various dispersion media in the primary liquefaction of coal by hydrogenation. Pittsburgh bed coal was used in all the experiments, and was hydrogenated in over thirty vehicles under mild conditions of temperature and pressure—namely, 400° C. and 67 atm. original hydrogen pressure. Previous claims in the literature that tetrahydronaphthalene is a good dispersion medium were confirmed, but of the other hydrocarbons used as dispersion media, only methylnaphthalene and diphenyl were of comparative effectiveness. Among the other media used were naphthalene, chrysene, decahydronaphthalene and *n*-hexadecane, which proved to be poor vehicles. Polar compounds such as phenols, and amines in the vehicles were found to be beneficial. The products formed in highest yield were pitches melting at comparatively high temperatures. Elementary analyses of these pitches showed that hydrogenation had increased the carbon and hydrogen contents, lowered the sulphur and oxygen contents and caused little change in the nitrogen content. H. E. T.

1238. *Iso*-Octane Production by Simultaneous Polymerization and Hydrogenation. V. N. Ipatieff and V. I. Komarewsky. *Ind. Eng. Chem.*, 1937, **29** (8), 958.—A new simultaneous reaction, called "hydropolymerization," of olefinic hydrocarbons takes place in the presence of a combination of polymerizations and hydrogenating catalysts.

By hydropolymerizing *iso*butylene in the presence of a solid phosphoric acid–nickel oxide–iron catalyst under hydrogen pressure, a mixture of isomeric octanes was produced. The experiments were conducted in a steel autoclave, the temperature was 250–300° C., reaction time 6–12 hours, and the conversion of *iso*butylene obtained was approximately 95%. H. E. T.

1239. Hydrogenation of some Benzene Hydrocarbons under High Pressure. M. K. Diakova, A. V. Losovoy and T. G. Stepantzeva. *J.I.P.T.*, 1937, **23**, 459–465.—An account is given of the hydrogenation of hexa-, penta-, and tetra-methyl benzenes, the xylenes and *n*-propylbenzene to the corresponding hexanaphthenes under a pressure of 120–230 atmos. and at 200–240° C. using a nickel catalyst. G. R. N.

1240. Pyrolysis of Ethane. H. H. Storch and L. S. Kassel. *J.A.C.S.*, 1937, **59**, 1240–1246.—These authors have investigated the decomposition of ethane in a special glass vessel at temperatures around 565° C.

The reaction has been followed by means of pressure measurements and analyses of the reaction products for methane, hydrogen and olefin content.

From the results obtained it is concluded that the production of methane is due to the two reactions, the rates of which have been determined, $C_2H_6 = CH_4 + \frac{1}{2}C_2H_4$ and $C_2H_6 + C_3H_4 (= C_5H_{10}) = CH_4 + C_5H_6$.

There is no measurable production of methane by the reaction $H_2 + C_2H_6 = 2CH_4$.

The initial rate of dehydrogenation of ethane is a first-order reaction from 200 mm. to 1500 mm. During a run the rate did not deviate measurably from $d(H_2)/dt = k(C_2H_6) - k'(H_2)(C_2H_4)$, but the presence of side reactions made an exact test of this relation impossible.

The authors consider that chain reactions contribute to only a few per cent of the total reaction, and outline a relatively simple classical mechanism which they believe accounts for the major part of the observed reaction. This mechanism is as shown below.

$$C_2H_6 \longrightarrow C_2H_4 + H_2$$
$$C_2H_6 \longrightarrow CH_4 + CH_2$$
$$CH_2 + C_2H_6 \longrightarrow CH_4 + C_2H_4 \text{ (rapid)}$$
$$C_2H_4 + C_2H_6 \longrightarrow C_4H_{10} \longrightarrow CH_4 + C_3H_6$$
$$\downarrow$$
$$H_2 + C_4H_8$$
$$C_2H_4 + C_2H_6 \longrightarrow CH_4 + C_3H_6$$

Additionally, the authors have determined the equilibrium constant in the ethane–ethylene–hydrogen equilibrium at 565° C. The average value for k atm^{-1} is 0·0087.

W. E. J. B.

1241. Viscometer with Suspended Level. L. Ubbelohde. *J.I.P.T.*, 1937, **23**, 427–451.—An account of experimental work on and the theoretical examination of the use of the suspended spherical level in the author's viscometer. It is shown that by its use the surface tension correction is eliminated in determining exact viscosities.

G. R. N.

1242. Viscosity Temperature Relations. M. Souders. *J.A.C.S.*, 1937, **59**, 1252–1254.—This paper presents a brief review of some common viscosity temperature relationships, and reports the results of testing the equation $\log_{10}(\eta/d) = A/T - B$ against data taken from the literature, for forty-seven organic liquids.

η/d represents the kinematic viscosity in millipoises at $T°$ Absolute, while A and B are constants. The compounds examined include hydrocarbons, halogenated hydrocarbons, ketones, ethers, alcohols, esters and an acid. In most cases the error is stated to be less than 1%, and the equation appears to be at least as accurate as Andrade's equation.

In some cases the data do not give a linear plot when the logarithm of the observed kinematic viscosity is plotted against the reciprocal of the absolute temperature, *e.g.* *n*-undecane and *m*-xylene gave plots which are slightly convex towards the temperature axis.

The divergences between the experimental data and the equation appear to increase with increase in the molecular weight of the compound rather than with increase in viscosity, whilst for materials of high molecular weight, such as petroleum oils, the equation is wholly unsatisfactory, except over short ranges of temperature.

W. E. J. B.

1243. Mechanism of Film Formation of Tars. J. G. Mitchell. *J.S.C.I.*, 1937, **56**, 253T–255T.—Film formation may generally be ascribed to oxidation (or other chemical action), polymerization, thixotropy and evaporation. In the case of tars, evaporation is considered to be the major factor, and this article deals with tars possessing a high initial rate of evaporation. Experimental facts determined and illustrated by curves and tabulated data are :—

(1) When tars made up from the same pitch and varying amounts of the same oil are exposed at 25°, the losses after 24 hours lie in the same order as the initial viscosities of the tars.

(2) Tars made up from the same pitch, but using oils containing varying percentages of low-boiling fraction (200–270°), give losses on exposure for 24 hours which again lie in the order of viscosities. The reduction of volatility does not greatly affect the rate of loss.

(3) When the temperature of exposure is raised to 35°, the losses again correspond with the viscosity of the tar at 35°—that is, two tars having equal viscosities at 25° and 35° respectively give equal losses when exposed at these temperatures.

(4) When the losses from the tars after the first 24 hrs. are plotted against time of exposure, curves are obtained which can be superimposed by selection of suitable origins, and if the same values are plotted in logarithmic form, the experimental points

give approximately straight and parallel lines. The total loss L may therefore be expressed as $L = IT^m$, where I is the loss in day, T the time of exposure, and m is a constant value of approximately 0·5; for these tars the curves are, therefore, part of paraboles.

It is recognized that the inference that initial viscosity is the deciding factor cannot be general, as vapour pressure will predominate in low-viscosity tars or those containing very volatile constituents.

When evaporation is aided by a draught, it is concluded that a stage is quickly reached when the rate of volatilization is determined by the rate at which the oil can be diffused to the skin, this rate of diffusion being to some extent dependent on the viscosity of the tar. Thus film formation is favoured when the rate of volatilization of the oil is greater than the rate at which the oil can diffuse through the tar.

The quantitative examination of film formation in tars presents great difficulties. The film does not appear to be confined only to the surface, but is more in the nature of a gradual change of viscosity through the surface layers. The development of film is being studied by (*a*) penetration by steel ball bearings, according to a method of the Road Tar Research laboratories of the Gas Light & Coke Co., and (*b*) by adhesion of sand to uniform strips of tar on smooth surfaces. T. C. G. T.

1244. Binary Systems of Some Fatty Acids. M. Kulka and R. B. Sandin. *J.A.C.S.*, 1937, **59**, 1347–1349.—These authors have determined composition freezing-point curves of the following binary systems of fatty acids, myristic–palmitic, capric–lauric, and undecylic–lauric.

The systems of capric and lauric, and myristic and palmitic show two transition points. The eutectic temperature for the capric–lauric system is 19·6° C. at a composition of 0·725 mole of capric acid and 0·275 mole of lauric acid. The eutectic temperature for myristic and palmitic acids is 45·2° C. at a composition of 0·725 mole of myristic and 0·275 mole of palmitic.

The freezing-point curve of the undecylic–lauric acid system shows no eutectic point, but indicates a small but definite change in direction near the middle of the system. This may indicate compound formation.

W. E. J. B.

1245. Ethylene. Heat Capacity from 15° K. to the Boiling Point, Etc. C. J. Egan and J. D. Kemp. *J.A.C.S.*, 1937, **59**, 1264–1268.—The authors have measured the heat capacity of ethylene from 15° K. to the boiling point. The melting point was found to be 103·95 ± 0·05° K., the boiling point 169·40 ± 0·05° K., the heat of fusion 800·8 ± 0·8 cal./mole, the heat of vaporization 3237 ± 3 cal./mole.

Additionally, the vapour pressure of liquid ethylene has been measured over the temperature range 123–170° K.

The entropy of ethylene at one atmosphere and at the boiling point has been calculated from the calorimetric data to be 47·36 cal./deg. per mole, which compares with the value 47·35 obtained from spectroscopic data.

The close agreement of these values substantiates the conclusion that no molecules other than hydrogen and deuterium, containing symmetrically placed hydrogens will have any residual entropy due to the persistence of rotation of the molecules in the crystal below 15° K. W. E. J. B.

1246. Diffusion Coefficient of Methane and Air. H. F. Coward and E. H. M. Georgeson. *J.C.S.*, 1937, 1085–1087.—This paper presents results obtained from experiments on the measurement of the coefficient of inter-diffusion between methane and air.

The apparatus used is described and illustrated, and a value for the diffusion coefficient at 0° C. and 760 mm. pressure is found to be 0·196 cm.²/sec. W. E. J. B.

1247. Vapour-Phase Hydration of Ethylene. M. P. Appleby, J. V. S. Glass and G. F. Horsley. *J.S.C.I.*, 1937, **56**, 279T–281T.—Cadmium metaphosphate, claimed to be the most active catalyst for the synthesis of ethyl alcohol from ethylene and water, was patented in 1930. A recent publication has claimed that the catalyst as prepared by the patentees was wholly inactive.

The paper is a vindication of the patent's claim and an elaboration of the technique

employed, together with experimental results. The failure to obtain the reaction with the patented catalyst is shown to be due to incorrect preparation of the catalyst.
T. C. G. T.

Analysis and Testing.

1248. Proposed Method for Determination of Specific Gravity. B. Anderson. *Tekn. Tidskr.*, 14.8.37, **67** (Kemi No. 8), 63–66.—The terms specific gravity and density are defined, and methods for their determination discussed and suggested for inclusion in specifications to be issued by the Swedish Standards Commission. For this purpose, specific gravity at 20/4° C., determined by aerometer, pychnometer or Westphal's balance, is suggested. It is stated that specific gravity shall be determined in order to allow volume/weight calculations, and because it can serve, in conjunction with other properties, as an indication of origin and composition of lubricants. R. F. S.

1249. Colorimetric Determination of Carbon Disulphide in Gas or Motor Fuels. Chemical Dept. of the South Metropolitan Gas Co. *J.S.C.I.*, 1937, **56**, 287T–290T.—A study of the colorimetric determination of carbon disulphide based on its reaction with diethylamine in alcohol, wherein is formed an amine derivative of diethyldithiocarbamic acid, which latter yields a greenish-brown coloration with cupric salts, has led to the development of a modified method more suitable for routine estimations.

In this modified method the carbon disulphide is absorbed in a solution containing 10 grm. of piperidine per litre of monochlorobenzene. The compound formed is quite stable, and the absorption of CS_2 is quite satisfactory even when the concentration is as low as 0·2 grain per 100 cu. ft. and when the gas flow is 1 cu. ft. per hour. The colour reaction is obtained with a solution of 2·5 grm. of cupric oleate per litre of monochlorobenzene. A photo-electric colorimeter using the Weston "Photronic" cell is used for the assessment of colours. The influence of impurities likely to effect results has been investigated and the results are listed.

The method may be applied to benzole and other hydrocarbon oils. T. C. G. T.

1250. Viscosity of Hydrocarbon Solutions. Methane–Propane–Crystal Oil System. B. H. Sage, B. N. Inman and W. N. Lacey. *Ind. Eng. Chem.*, 1937, **29** (8), 888.—The viscosities of mixtures of crystal oil, methane and propane were measured in a rolling-sphere viscometer at 100° F. and at pressures between the bubble-point and 3000 lb. per sq. in. The viscosity of neat crystal oil was measured over the range 100–220° F., 0–3000 lb. per sq. in.

The methane–crystal oil mixtures contained up to 4·0% by weight of methane, and the propane–crystal oil mixtures up to 17·54% of propane. The mixtures of the three components contained quantities of methane and propane covering the same ranges.

The results are presented graphically and in two tables. P. D.

1251. Collected Results on Viscosity of Lubricants Under Pressure. I. Fatty Oils. M. D. Hersey and R. F. Hopkins. *J. Applied Phys.*, 1937, **8** (8), 560.—The reported results on the viscosity of castor, lard, rapeseed, sperm, camellia-seed, hemp, horse and whale oils are presented in tabular form in such a way that they may easily be graphed. The data are from the A.S.M.E., Hyde, Kiesskalt and Suge. The suggested form of graphing is to plot values of Z/Z_1 (Z = viscosity at p ats. Z_1 = viscosity at 1 at.) against p to give lines for various temperatures, and to plot Z_1/Z_0 (Z_1 = viscosity at $t°$ C., 1 at., Z_0 = viscosity at 25° C. and 1 at.) against t. From such graphs and a value for Z_0 the complete behaviour of the oil may be determined. P. D.

1252. Carbonization of Lubricating Oils. H. N. Bassett. *Engineer*, 1937, **164** (4257), 176.—The tendency of lubricating oils to carbonize in an engine is measured in the laboratory by various methods; these may be grouped into coking tests, oxidation tests and volatility tests. Coking tests fail to indicate adequately the behaviour of the oil in the engine in relation to carbon deposition. Oxidation tests are satisfactory only where straight distillates are concerned, and fail when oils are blended with residual cylinder stocks. The carbonization index (the temperature at which 90% of the oil is distilled off under 1 mm. absolute pressure) is considered to give a fair

indication of the behaviour of the oil under working conditions, provided the oil is not one which cracks easily. A general review is given of attempts to correlate specific examples of coking, oxidation and volatility tests with the performance obtained in engines. J. W. H.

1253. Method of Measuring the Non-Viscous Coefficient of Friction of Lubricants. S. Kyropoulos and E. I. Shobert. *Instruments*, 1937, **10** (7), 185.—The non-viscous or boundary lubricating properties of an oil can be measured in a pendulum-type friction machine using a plain bearing resting on four ball bearings. Wearing of the ball bearings is not disadvantageous. The effects of viscosity can be overcome by raising the temperature. P. D.

1254. Coefficient of Static Friction of Lubricating Oils. D. J. W. Kreulen. *J.I.P.T.*, 1937, **23**, 452–458.—Experiments are described on the use of the Redgrove oiliness apparatus for the determination of the static friction coefficient of lub. oils and the results are briefly discussed in relation to the compositions of the samples examined. G. R. N.

Motor Fuels.

1255. Alcohol Motor Fuels. A. R. Ogston. *J.I.P.T.*, 1937, **23**, 506–523.—A comprehensive discussion of alcohol motor fuels covering the historical development, manufacture, blending, corrosion and solvent effects, cylinder wear, effect on engine efficiency, use of higher alcohols and the possibilities of use in aircraft. G. R. N.

1256. Proposed Swedish Motor Fuel Specifications. Anon. *Tekn. Tidskr.*, 17.7.37, **67** (Mekanik No. 7), 27–29.—A committee appointed by the Departments of Mechanical and Chemical Technology of the Swedish Association of Engineers and Architects have proposed specifications for Motor Gasoline, "Lättbentyl" (25% Alcohol blend), four grades of aviation gasoline, two grades of motor kerosine, two grades of gas oil, light fuel oil, and two grades of heavy fuel oil, as follows:

TABLE 1.

Volatile Fuels.

Type of Fuel.	Motor Gasoline.	Lätt-bentyl.	Aviation Gasoline.				Motor Kerosine for Carburettor engines.
			70 Octane.	74 Octane.	80 Octane.	87 Octane.	
Specific Gravity, 20/4° C. max.	0·770	0·780	0·790	0·790	0·790	0·790	0·820
Distillation Engler–Ubbelohde:							
I.B.P. max.	50° C.	50° C.	—	—	—	—	170° C.
10% over at	60/75° C.	50/65° C.	max. 70° C.	max. 70° C.	max. 70° C.	max. 70° C.	—
50% over at max.	125° C.	80° C.	100° C.	100° C.	100° C.	100° C.	210° C.
F.B.P. max.	205° C.	205° C.	180° C.	180° C.	180° C.	180° C.	290° C.
95% over at max.	F.B.P.	F.B.P.	160° C.	160° C.	160° C.	160° C.	F.B.P.
Vapour Pressure max. at 38° C.	—	—	0·5 kg./cm.²	0·5 kg./cm.²	0·5 kg./cm.²	0·5 kg./cm.²	—
Octane No. min. C.F.R. M.M.	65	—	70	74	80	87	See below
Tetraethyl Lead Content	See below	none	none	none	may contain	may contain	—

The above grades must be clear, well refined, free from water and mechanical impurities and neutral towards litmus. When refluxed on water-bath for 3 hours, polished strips of copper, iron and zinc must show no noteworthy signs of corrosion or staining. The 10% point for gasoline and lättbentyl should approach the lower limit in winter and the upper limit in summer. Regarding motor kerosine, an octane no. of 40 is stated to be desirable, although not definitely specified. Addition of benzol is suggested as a means to improve the octane no. of motor kerosine, if necessary. The flash-point of this grade should lie between 40° C. and 50° C. Regarding the use of tetraethyl

lead, the proposed specifications stipulate that it may be used in gasolines with octane nos. above 80, but that it must not be present in gasolines with octane nos. below 80.

TABLE II.

Fuel Oils.

Type of Fuel.		Motor Kerosine.	Solar Oil A.	Solar Oil B.	Light Fuel Oil.	Heavy Fuel Oil A.	Heavy Fuel Oil B.
Viscosity centistokes at 20° C.		—	max. 9	max. 9	max. 30	above 30	above 30
Flash-point ° C.	min.	40	65	65	65	65	65
Cold Test: shall be wholly fluid at temp. above ° C.		—	− 20	− 5	+/− 0	See below	See below
Hard Asphalt	max.	—	0·1%	0·1%	0·7%	1·5%	1·5/12%
Ash	max.	—	0·01%	0·01%	0·03%	0·12%	0·12%
Water	max.	—	0·1%	0·5%	1·0%	1·0%	1·0%
Mechanical Impurities	max.	—	trace	trace	0·1%	0·5%	0·5%
Sulphur	max.	—	1·5%	1·5%	2·0%	2·0%	—
% distilled at 290° C.	min.	95%	—	—	—	—	—
% distilled at 350° C.	min.	—	90%	90%	—	—	—
Net Calorific Value kg.cal./kg.	min.	10·000	10·000	10·000	10·000	9·800	9·500

The "lättbentyl" shall be a blend of 25% + / − 3% motor alcohol and 75% +/− 3% gasoline. The motor alcohol shall contain at least 99% ethyl alcohol, and shall be denatured with crotonaldehyde. No separation may occur, or cloudiness appear, if 300 c.c. are shaken with 2 c.c. water at 20° C., or if it is chilled to −40° C. The pour points of the heavy fuels should be low enough to permit handling. In addition to the above, specific gravity shall be determined, although no requirements are imposed. The oils shall, furthermore, be of mineral oil origin.

The committee invites comments, which should be sent to the secretary, Mr. S. Ejermark, Nockebyvägen 75, Nockeby, Sweden. R. F. S.

1257. Aircraft Fuel Specifications. W. H. Hubner, G. Egloff and G. B. Murphy. *Nat. Petr. News*, 28.7.37, **29** (30), R. 57.—The paper is a comprehensive survey of the methods of assessing ignition quality, the significance of specific characteristics of the fuel, expert opinion relative to the use of high octane number fuel and its future possibilities. Three methods are in current use for the determination of octane numbers, viz. (1) Army Method. U.S. Army Specification No. 2–94. (2) C.F.R. Motor Method. A.S.T.M. D. 357–36T. (3) C.F.R. Modified Motor Method. British Air Ministry Specifications D.T.D. 224 and 230. Insufficient data are available for a critical comparison of the three methods, but it is believed that method (1) rates certain fuel lower than methods (2) and (3). Sundry promising modifications designed to render the testing of fuels of high ignition quality more reliable are being examined. The specification of 10%, 50% and 90% end-point temperatures vary considerably. The variations are due to the relative importance given to distribution and the formation of ice on carburettors. It is suggested that 167, 212 and 275° F. are satisfactory minimum figures. Distribution difficulties would be solved by the general adoption of the fuel injection system, but this system appears to have lost some of its initial favour. An accelerated ageing test and/or some form of acid/heat test is useful in controlling the amount of unsaturateds or organic materials added to contribute some special property. The general consensus of opinion indicates that high octane number fuels will come into general use, especially for aviation. *iso*-Octane is destined to remain the principal blending agent in the preparation of high-octane-number fuels. H. G.

1258. Patents on Motor Spirit. Standard Oil Development Co. E.P. 468,488, 6.7.37. Increasing the octane number of naphtha by the action of activated aluminous material or naphtha vapour at 900–1050° F.

N.V. de Bataafsche Petroleum Mij. and J. W. Givens. E.P. 469,573, 28.7.37. Sweetening of sour hydrocarbon distillate containing mercaptans by extraction with a quaternary ammonium base.

C. C. Towne. U.S.P. 2,086,287, 6.7.37. Increasing the anti-knock value of motor spirit by subjecting the vapours at 500–700° C. to the action of bauxite impregnated with nickel oxide.

W. A. Schulze. U.S.P. 2,087,048, 13.7.37. Catalytic desulphurization of petroleum hydrocarbons, *e.g.* gas oil and lighter fractions, by passing the hydrocarbon vapours in contact with first bauxite at 600–730° F. and then with bauxite above 730° F. and removing the decomposed sulphur compounds.

J. C. Morrell and G. Egloff. U.S.P. 2,087,525, 20.7.37. Refining of light distillates by means of hydrochloric acid and steam and free oxygen in the presence of active clay. W. S. E. C.

Lubricants and Lubrication.

1259. Patents on Lubricating Oil. Standard Oil Development Co. E.P. 468,081 29.6.37. Lubricant comprising mineral lubricating oil together with less than 1% of an oil-soluble linear polymer of *iso*butylene (mol. wt. >30,000) and less than 2% of a sodium soap.

Standard Oil Co. of California. E.P. 468,283, 30.6.37. Production of synthetic lubricating oil by polymerization of gaseous olefines.

L. A. Herrmann and T. G. Roehner. E.P. 468,688, 6.7.37. Preparation of cutting oil consisting of a lubricating oil, an emulsifying agent, a small quantity of sulphur, a rosin soap base and alcohol.

R. L. H. Smith. E.P. 468,854, 14.7.37. Apparatus for testing bearing metals or lubricants.

R. Meyer. E.P. 469,520, 27.7.37. Process for the regeneration of used lubricating oils.

L. Laskaris. U.S.P. 2,085,759, 6.7.37. Imparting green bloom to hydrocarbons by heating coal-tar pitch containing green fluorescent bodies to 600–700° F. in intimate contact with caustic soda, cooling and contacting pitch with a hydrocarbon oil and separating therefrom the insoluble portion of pitch.

C. C. Towne. U.S.P. 2,086,484, 6.7.37. Solvent extraction of petroleum oils using resorcinol monomethyl ether.

D. R. Merrill. U.S.P. 2,086,168, 6.7.37. Solvent extraction of lubricating oil using liquid SO_2, furfural, etc.

W. H. Bahlke, F. W. Sullivan, Jr., and R. E. Wilson. U.S.P. 2,086,487, 6.7.37. Solvent extraction of lubricating oil using propane.

E. D. Bradford. U.S.P. 2,086,763, 13.7.37. Oil-reclaiming apparatus.

F. X. Govers. U.S.P. 2,087,473, 20.7.37. Solvent refining of lubricating oil using ethyl levulinate.

P. L. Salzberg. U.S.P. 2,088,441, 27.7.37. Solvent extraction of lubricating oil using furfurylamine.

H. I. Waterman. U.S.P. 2,088,500, 27.7.37. Refining of mineral oil containing sulphur compounds by acetylenization in the presence of a polymerizing catalyst. W. S. E. C.

Asphalt and Bitumen.

1260. Adsorption of Bitumens by Road Aggregates. J. R. Ramchandani. *J.I.P.T.*, 1937, **23**, 491–505.—Experiments are described on the measurement of the adsorptive capacity of an aggregate for bitumen using a turbidimeter to evaluate the surface area of the aggregate and a colorimeter known as a Panchrometer to determine the exact quantity of adsorbed bitumen. G. R. N.

1261. Patents on Asphalt. E. F. Nelson. U.S.P. 2,085,992, 6.7.37. Improvement in air-blowing of asphaltic material by adding a small quantity of anti-oxidant, *e.g.* alpha-naphthol, hydroquinone, etc.

H. M. Stafford. U.S.P. 2,086,968, 13.7.37. Preparation of water-proofing bituminous composition for coating mineral aggregate consisting of 50% of asphalt (penetration 200–300 at 77° F.), 30% of petroleum naphtha, 10% of kerosine and 10% of tar naphtha. W. S. E. C.

Special Products.

1262. Patents on Special Products. Distillers Co., H. Muggleton and J. E. Youell. E.P. 467,228, 3.6.37. Production of glycol ethers.

Standard Oil Development Co. and I.G. Farbenindustrie A.-G. E.P. 467,932, 25.6.37. Production of viscous to plastic solid polymers of *iso*butylene by polymerizing a mixture of *iso*butylene and butanes using boron fluoride as catalyst at temperatures below — 40° C.

Deutsche Erdöl A.-G. E.P. 468,105, 29.6.37. Production of pure paraffin wax from lignite tar, shale tar, peat, etc. The crude wax is first separated by filtration and treated with phenols of low b.pt., to eliminate the creosote. The remaining undissolved paraffin wax is then sweated.

W. Wilkinson. U.S.P. 2,044,414, 16.6.36. Catalytic hydration of ethylene and propylene with dilute H_2SO_4 as catalyst to produce ethyl and *iso*propyl alcohols respectively.

F. R. Balcar. U.S.P. 2,044,417, 16.6.37. Catalytic hydration as described above using dilute phosphoric acid as catalyst. W. S. E. C.

Coal and Shale.

1263. Low-temperature Carbonization of Bituminous Coal. D. Brownlie. *Ind. Eng. Chem.*, 1937, **29** (7), 734.—The latest developments in the low-temperature carbonization of bituminous coal which have taken place in Great Britain and Germany are reviewed. In Great Britain 327,112 long tons of coal were carbonized under low-temperature conditions, 85% of this was carbonized by the Coalite process; this throughput is a 50% increase on the 1930 figure. Five British processes, eight new (post 1932) and two of the older German processes are briefly described.

J. W. H.

1264. Patents on Coal. N. H. Freeman. E.P. 468,707, 9.7.37. Extraction of liquid hydrocarbons from coal, shale, etc. W. S. E. C.

Economics and Statistics.

1265. Fuel Supplies of Great Britain. A. W. Nash. *Fuel Economist*, June, 1937, **12** (141), 315–317.—The production of coal in Great Britain in 1913 amounted to approximately 287,000,000 tons, whereas in 1935 production was 222,000,000 tons, a decline of 65,000,000 tons.

Analysis of the coal demands indicates that the decreases in the export of coal, coke and manufactured fuel, represented nearly 35,000,000 tons, whilst about 14,000,000 tons represented the decrease in coal used for industrial purposes. Over 90% of the decrease in home consumption has resulted from the diminished use of coal in blast furnaces, steel works and in collieries themselves. This fall in consumption has not resulted solely from trade depression, but improvements in methods of production have resulted in less coal being used per unit of product.

Coal used for domestic purposes has declined by 5,000,000 tons over the above period, and this may be attributed to the increased use of gas and electricity for heating.

In regard to the use of oil it is interesting to observe that during 1929 and 1935 coal bunkering declined by about 4,000,000 tons, whereas oil bunkering increased by only

138,000 tons in the same period; thus this reduction in the use of coal can hardly be ascribed to replacement by oil.

In regard to the fall in coal consumption for industrial and domestic purposes from 1913 to 1935, *i.e.* about 19½ million tons, the present internal consumption of fuel and diesel oil for these purposes is stated to be about 1½ million tons per annum. This is equivalent to just over 2 million tons of coal, or about 11% of the fall in coal consumption.

The author concludes that the extent to which oil has encroached directly on the coal markets of this country must be comparatively small.

The concluding section of the paper refers to the oil industry as a coal user, and emphasizes the large amount of money expended in this country for stores and equipment, tankers, wages and contribution to the Exchequer, all of which refutes the suggestion that the sole beneficiary of the sale of petroleum is a foreign country. W. E. J. B.

1266. Russian Oilfields in 1936. B. B. Zavoico. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 1074–1078.—The most important discoveries during 1936 were supplied by the Caucasus, the more outstanding of these being the Izberbash and Achi-Su fields on the shore of the Caspian Sea in Dagestan.

The production in Izberbash is obtained from the Chokrak Series (Miocene), the initial production reaching as much as 4000 brls. per day from depths of 5000–6000 ft. Structurally, the field is a large anticline cut in two by a fault having a throw of 1000 ft. Achi-Su, although giving much smaller initial production (70 to 200 brls. per day) at a shallow depth of 2400 ft., is nevertheless expected from surface indications to cover an immense area; this, therefore, represents a large reserve.

On the Apsheron Peninsula important discoveries and extensions were proved during the year. The Surakany field (the deepest producer yet completed in Russia) yielded about 4000 brls. per day at 8150 ft. from pre-Kirmaku sands.

Several important developments took place in the Puta district, including discoveries and extensions at Shangar, Kergez and Kizil-Tepe. In the N. Caucasus (Maikop and Kuban districts) several small fields of much promise were discovered. In the Ural Permian basin the Ishimbaevo field (in Bashkir Steppes) produced 6,780,000 brls. at the rate of 18,500 brls. per day; this production was to be doubled in 1937.

Progress in the Russian oil industry, although slow, is gradually but definitely being made. A large number of structures which have already been mapped are awaiting exploratory drilling, and by further geological prospecting work it is thought that the country will be supplied with all the fields it needs for the next twenty-five years or more. G. S. S.

1267. Russian Petroleum Exports after the Nationalization. I. Ganitzki. *Mon. Petr. Roum.*, 1937, **38**, 1111–1114.—The article tabulates the growth of the Russian petroleum exports from 1920 and recalls the period of price-cutting later exploited. In 1923 England, Egypt and British India imported more than a half of Russia's exports.

The development from about 1925 of subsidiary companies such as the British R.O.P., in foreign countries, is outlined. At about this time Russia also entered into agreement with the big American oil interests. A table illustrates the imports of Russian petroleum products by numerous countries during the years 1929–1936. From this table it is evident that England reached her peak of Russian oil imports in 1931, with 1,084,380 tonnes, and that though English imports dropped to 621,610 tonnes in 1932, Russian exports rose from 5,279,400 tonnes in 1931 to a peak of 6,106,600 tonnes in 1932—in fact, England was the only country to register an appreciable drop in Russian oil imports. From 1932, however, the Russian exports of oil have dropped rapidly, being in 1936 only 2,653,280 tonnes. Of this quantity France, 367,000 tonnes, Germany, 347,940, and England, 302,130, were the main importers. It is also apparent from the table that only the countries in the vicinity of Russia, such as Finland, Lithuania, Norway and Mongolia, are maintaining a steady import of Russian oil.

A further table indicates that the bulk of the reduction in Russian exports has been in motor spirit and fuel oil. Exports of spirit in 1932 were 2,016,000 tonnes, and of fuel oil 1,901,000. These figures dropped in 1936 to 426,000 and 867,000, respectively. Gas oil and lubricating oil remain fairly steady, the first between 550,000 and 600,000, and the latter between 200,000 and 300,000 tonnes.

The reduction in Russian oil exports is due to three causes: (1) The increasing de-

mand of the home market due to rapid mechanization of industry; (2) the rapid development of home industry has reduced Russian imports and hence her need for a bartering material such as petrol; (3) the production of gold in Russia has risen from 25,150 kgms. in 1926 to 226,713 kgms. in 1936. T. C. G. T.

1268. Coal Reserves of the U.S.S.R. I. Ganitzki. *Mon. Petr. Roum.*, 1937, **38**, 1183–1185.—Calculations in 1923 set Russia's probable coal reserves at 419,999,000,000 tonnes. This figure has now been raised to 1,083,000,000,000 tonnes, or about 18% of the world's probable reserves. Russia's possible and probable reserves are estimated at 1,600,000,000,000, against a world possible of 14,350,000,000,000 tonnes.

The reserves of various fields are listed and valued by converting these quantities to a common value based on the calorific value of the coal. Thus, a tonne of Donetz field anthracite is given unit value, whilst a tonne of Boghead coal is valued at 0·46. By far the greatest proportion—87%—of Russian coal is found in Asia, and the richest region is that of Kuznetzk.

Various fields are under development throughout European and Asiatic Russia in such diverse places as the borders of the White Sea, in the Kamtchiatcha and Tchukotsk peninsulas on the Behring Sea, and in Akmolinsk on the borders of Turkestan. The outputs and prospects of all these fields are outlined. T. C. G. T.

BOOK REVIEWS AND BOOKS RECEIVED.

Book Reviews.

LOUISIANA GEOLOGICAL SURVEY. BULLETIN 8. LOWER MISSISSIPPI RIVER DELTA; REPORTS ON THE GEOLOGY OF PLAQUEMINES AND ST. BERNARD PARISHES (LOUISIANA). Richard Joel Russell, Henry V. Howe, James H. McGuirt, Christian F. Dohm, Wade Hadley, Jr., Fred B. Kniffen and Clair A. Brown. Richard Joel Russell, Editor. Pp. xiii + 1–454; figs. frontispiece, 36, cover map; pls. 17. Louisiana Geological Survey (Research Division). New Orleans, November 1st, 1936. (Distributed, May, 1937.)

The separate reports included in the volume are: *Physiography*, Russell, 199 pp. *Salt domes*, Howe and McGuirt, 79 pp. *Petrography* (of two sub-deltas and extraneous pebbles on Chandeleur Islands), Dohm, 64 pp. in two reports. *Archæology*, preliminary report on Indian mounds and middens, Kniffen, 16 pp. *Vegetation* of mounds, middens and marshes, Brown, 18 pp. *Recent mollusca*, Hadley, 4 pp. *Bibliography*, Russell and Dohm, 42 pp., and *List of Maps*, Dohm, 18 pp., two most extensive lists. A detailed *Index*, 14 pp.

The salt-dome paper in this report is not here reviewed. Petroleum geologists not primarily concerned with physiography will wish to acquaint themselves with the author's views of the origin of the Gulf Coast Geosyncline by subsidence of a tertiary deltaic complex under the load of accumulating sediments. The dominating influence of the Mississippi delta in this process is stressed. Active subsidence and Gulfward tilt in the delta to-day seem to be established by this investigation. The reviewer, in an extended personal conference with Russell and Howe, has found that the results of his studies of the Texas and Mexican shorelines harmonize and integrate well with the Pleistocene and Recent history of the Louisiana coast as pictured by Russell.

This seems to be the first comprehensive study of a great sea-level delta of the coastal plain type. The old text-book concept of a delta as composed of topset, foreset and bottom-set beds has no place in delta structure as here described. The ideas of delta structure and history as here set forth, if accepted, should profoundly influence our interpretation of the stratigraphy, sedimentation history and tectonics of geosynclinal basins in which the strata are dominantly of shallow-water origin, or in which thick series of shallow-water beds occur.

Physiographers will find here much meat, not only in the description of a delta, but also in subsidiary features, such as the formation of an offshore bar by subsidence, meanders in tidal streams, lack of meanders in the active distributaries of this delta, critical angle of bifurcation of distributaries in relation to their persistence and the use of studies of soils, vegetation and archæology in the interpretation of shoreline history.

Geologists generally have strangely overlooked, until the present decade, the opportunities for the discovery of new and important facts to be learned from intimate studies of deltas. However, deltas are among the most inaccessible places on earth, and it is only through the aid of recently developed facilities that detailed studies of deltas are now accomplished with relative ease. These developments include: (1) improved transportation facilities, (2) airplane photograph mosaics and maps drawn from them, (3) recent developments of soil science, and (4) the beginning of topographic mapping of coastal areas with small contour intervals—1 foot to 5 feet—and using an aerial photograph base.

To study this volume the reader should provide himself with a general map of southern Louisiana showing the hydrographic pattern and place-names. Such a map is the U.S. Army Engineers' map, scale 6 miles to 1 inch, price one dollar, edition of 1934 (1937 edition forthcoming). The coast charts and topographic maps of the region will be of much assistance, as the book is not abundantly illustrated.

The report reads easily and has a detailed index. The reviewer regards it as one of the most important contributions to fundamental geology which has appeared in recent years, and the best of the excellent series of recent studies of coastal geology published

by the Louisiana Conservation Commission. The work was planned by Richard Joel Russell, with the collaboration of H. V. Howe. It is an excellent example of a piece of co-operative research directed by an experienced physiographer. W. A. P.

THE ART OF CARBURATION. R. W. A. Brewer. Pp. xii + 176. Figs. 63. Tables 20. Technical Press, Ltd., London. 1937. 21*s*.

This book is a welcome addition to the automobile engineers' technical library, containing much important and not generally available data.

The physical aspects of carburation and their relation to the mediums concerned are thoroughly and clearly discussed.

The historical section, relating chiefly to carburettors, runs up to about the end of 1925, readers apparently being presumed familiar with more modern instruments; this, however, is no reflection on the soundness of the basic principles as expounded by the author.

After reading this book, one is left with the impression that the title might be the "Science" rather than the "Art" of carburation. L. G. C.

PETROLEUM. L. Nauwelaerts. Pp. 311. Illus. 30. N.V. Het Nederlandsche Boekhuis, Tilburg (Holland). f. 3.50

Since the War a great number of popular books on the petroleum industry have been written, unfortunately many of them by incompetent journalists with a political axe to grind or with the veiled object of reviling one of the oil magnates.

Mr. Nauwelaerts' book is not of this class, but the fact that it aims at being something more than the usual popular book justifies a higher standard of criticism being applied to it. The beginning of the book, in fact, is so admirable that it is to be regretted that the author has included some of the fantastic romances already published in regard to the petroleum industry, and has allowed so many statistical and historical inaccuracies to occur.

The cited literature often forms a key to the book in question, and it is surprising, therefore, to find that Mr. Nauwelaerts has made use of such a superficial work as that by A. E. Zischka, while most of the classical and standard works have been ignored. For instance, the excellent pamphlet of H. Witkamp *de Petroleum* (Tjeenk Willink, 1918) is not mentioned, and although reference is made to the work of Prof. Dr. C. Gerretson, it appears that the author has not made much use of it.

The illustrations are good, but it is unfortunate that the photograph facing page 160, stated to be of "Sir Marcus Samuel" (the late Viscount Bearsted), is of the Right Hon. Sir Herbert Samuel, P.C., the Liberal statesman!

The book as a whole is written in an attractive and readable style. The description of Japan's need for expansion and of the rise of Soviet Russia to her present position as one of the foremost petroleum producing countries in the world are admirably treated, and the same may be said of the introductory chapter "From Well to Consumer."

The book, which is in Dutch, has been translated into German (Paul List Verlag, Leipzig). B. T.

PETROLEUM AND NATURAL GAS BIBLIOGRAPHY. Robert E. Hardwicke. Pp. 167. University of Texas, Austin. 1937.

If, as the author writes in his preface, the wise leave bibliographical research to the foolish, the present work has been compiled by a very wise fool. The initial use was to build up a good working library; thus, a list of relevant books on this subject was necessary.

Hardwicke is a lawyer and economist by training and experience, and has dealt with technical, economic, legal and general aspects of the subject with a thoroughness typical of those professions. The book consists of 167 pages, 1397 references and an author index placed at the end. It contains copyrighted material recorded in the Library of Congress, together with items of general interest found elsewhere. The general headings cover all aspects of petroleum and natural gas including books only. The author has wisely excluded periodical references and patent literature but has included a section on catalogues, indexes and abstracts.

The following classification is adopted: General and Historical, Finding and Prospecting, Development and Production, Transport and Storage, Refining, Analysis and Testing of Petroleum and Natural Gas and their Products, Economics and Statistics, Legal, Hearings, Investigations, Reports and Findings of Political Nature by branches of the Congress, Departments and Bureaux of the Government of the United States, Accounting and Finance, Bibliographies, Indexes and Lists of Publications. Each individual section contains a list of published books to February 1937, which are arranged alphabetically under authors, together with the number of pages, publisher and price.

This bibliography should prove invaluable to anyone building up a library on the subject and as a reference book on relevant literature on petroleum and natural gas.

It should be noted that the profits from the sale of the book go to the library on petroleum technology of the Texas University. W. S. E. C.

AN INTRODUCTION TO HISTORICAL GEOLOGY. W. J. Miller. Pp. x + 499. Van Nostrand Co., Inc., New York, 1937. Chapman and Hall, Ltd., London. 15s. net.

The appearance of the fourth edition of this work, which was originally published in 1916, will be welcomed by teachers and students alike, although its appeal on this side of the Atlantic will be more limited than in the United States. For oil geologists, of whatever nationality, a knowledge of the main outlines of the historical geology of that part of the globe which still produces more than half of the world's petroleum is of primary importance, and this book forms an excellent introduction to the subject.

In its essentials, the present edition differs but slightly from its predecessors although it has been enlarged, new illustrations have been added and new material, dealing with advances in geological knowledge over the nine years which separate this from the third edition, has been included. As indicated in the sub-title, the book deals chiefly with North America. The Eastern Hemisphere and South America are almost completely ignored, except for short paragraphs at the ends of the chapters dealing with the several geological Systems. The extra-American sections are, in fact, so condensed that it will be often difficult for the European student to connect and compare his local data with that set out in this volume. Otherwise, the average student's difficulties have been met—to the point of redundance in some instances.

The exposition is lucid and brightly written; it abounds in relevant (rarely dated, alas!) quotations, and the author has succeeded in crowding a comprehensive and readable account of the Geological History of North America into 500 pages.

That is no mean achievement!

In common with most American text-books, the volume is clearly printed on thin, opaque, but rather too glossy paper. It is copiously illustrated, although some of the diagrams have been reduced to an extent which makes the legends and details almost undecipherable. Some of the photographs suffer from the same defect aggravated, occasionally, by under-exposure.

These, however, are minor faults, and the book can be recommended to all students who wish to obtain a sound foundation of geological evolution as revealed in the United States of North America.

The index is adequate, but the short bibliography might advantageously be extended. L. O.

A.S.T.M. STANDARDS ON PETROLEUM PRODUCTS AND LUBRICANTS—1937. Prepared by Committee D-2 on Petroleum Products and Lubricants. Pp. vi + 385. A.S.T.M. 260, S. Broad St., Philadelphia, Penna. $2.

With minor modifications and one or two additions, the 1937 "Methods of Testing" follow closely on the lines of the immediately preceding issues.

The most important addition is the "Proposed Method of Test for Dropping Point of Lubricating Greases" (Appendix I). This is on the general lines of the almost universally adopted Ubbelohde method, with modification of the metal parts and cup. It is to be noted that the method is only "proposed," and published as information only. The proposal at this time is perhaps not very opportune, in view of the Drop Point test for greases having been referred to a special Committee of the International Standards Association (comprised of representatives of the national Standards bodies of Germany, Belgium and Great Britain) for report, and it is generally known that the

method has recently been occupying the attention of the Grease Panel of the I.P.T., and the Chemical Divisional Council of the B.S.I.

Appendix II is again a "proposed" method dealing with "a Test for the Unsulphonated Residue of Plant Spray Oils"—a class of products not included in the I.P.T. "Standard Methods."

The determination of kinematic viscosity with suspended level viscometers, and alternatively a modified Ostwald, is now included as a tentative method, having appeared in last year's Report simply as a "proposed" method.

Appendix III deals with the conversion of kinematic viscosity to Saybolt. It is pointed out that the trend towards the measurement in kinematic units is developing a real need for a reliable method of conversion, since the industry will continue to specify Saybolt seconds for some time to come.

Since the work started five different conversions have been developed from experimental results, no two of which were in entire agreement. Excellent agreement, however, existed between four of them over certain ranges, and it seemed advisable to use the average of these five conversions as a basis for a new one.

Four viscosity temperature charts are now available as tentative standards, and it is noted that, in addition to their primary purpose, these furnish a convenient means for estimating the viscosity, at a given temperature, of blends, provided viscosities of the component liquids at the given temperature are known.

The two former tentative tests for vapour pressure for natural gasoline and motor and aviation gasolines have been consolidated in one, using the Reid apparatus.

Some specifications are included; that for gasoline (tentative standard) covers three types arranged with geographical and seasonal variations. "These Specifications are for the use of Purchasing Agents in formulating specifications for purchases of Gasolines under contract." It is of interest to note that no sulphur limit is imposed, but in a footnote it is stated "in 1937 gasolines containing up to 0·25% of sulphur were being distributed in the United States."

For Diesel fuels, on the other hand, a "classification" agreeing with that of previous years is reproduced, and this includes a notification that it is not the intention of the Committee that the classification should be used as Purchase specifications. This is a matter of some interest in this country, in view of the practice of the Petroleum Industry Committee of the British Standards Institution in adopting classifications rather than specifications. J. S. S. B.

Books Received.

Department of Scientific and Industrial Research:

FUEL RESEARCH BOARD TECHNICAL PAPER NO. 45. THE HYDROGENATION-CRACKING OF TARS, PART III—THE EFFECT OF CERTAIN VARIABLES IN A CONTINUOUS PLANT. Pp. 45. H.M. Stationery Office. 1s. net.

The hydrogenation-cracking process has been under investigation at the Fuel Research Station for a number of years, and the present series of reports gives an account of the course of the work and of the results achieved.

The present report—Part III—deals with the effect of a number of variable factors on the working of a continuous hydrogenation-cracking plant. The possible variables in such a plant are the concentration of the catalyst on the support, the size of the catalyst granules, the nature of the raw material, the temperature, the pressure, the time of contact, and the relative concentrations of tar and hydrogen. In studying these, each factor was varied independently of the other, and attention was paid chiefly to their effect on the activity of the catalyst, which was measured by the degree of conversion of the tar to spirit.

The results of the experiments show that the initial activity and rate of deterioration of the catalyst are not necessarily, or even usually, affected in the same manner or to the same degree by changes in a particular variable. For instance, within certain limits a rise in temperature of the reacting materials produces initially a marked increase in the yield of spirit, but this is offset to some extent by the rapid deterioration

of the catalyst. The temperature should therefore be chosen so as to give a maximum yield of spirit over a given period of time. On the other hand, an increase of pressure, while producing only a slight improvement in the initial yield, greatly reduces the rate of deterioration of the catalyst, so that good yields are maintained over a longer period. Similar considerations, it is shown, apply to changes in the other variables.

GEOLOGICAL SURVEY OF GREAT BRITAIN. GOSFORTH DISTRICT. (*One-Inch Geological Sheet* 37 *New Series*.) F. M. Trotter, S. E. Hollingworth, T. Eastwood and W. C. C. Rose. Pp. xii + 136. Plates 6, figs. 15, index. H.M.S.O. 3*s*. 6*d*.

The region described in this memoir forms part of the iron-ore field of West Cumberland. So far as the solid formations are concerned, the rocks of the district fall naturally into three groups: pre-Carboniferous, Carboniferous and New Red Sandstone. The Glacial history is chiefly concerned with two episodes—the Main Glaciation and the Scottish Readvance Glaciation. The post-Glacial deposits comprise Submerged Forest, Raised Beach and associated warps, river terraces and alluvium, peat and blown sand.

American Petroleum Institute:

A.P.I. CODE OF METALLURGICAL TERMS FOR FERROUS ALLOYS. A.P.I. Code No. 28. First Edition, August, 1937. Pp. 15. American Petroleum Institute, New York. 25 cents.

This Code was prepared by the Division of Production, A.P.I., to promote uniformity of meaning in the usage of metallurgical terms when applied to oilfield equipment. In the compilation of the Code free use was made of the publications of the A.S.T.M., the American Society for Metals and the S.A.E.

The first portion of the Code consists of a list of about 250 familiar terms in ferrous metallurgy, together with their definitions (*e.g.* calorizing, eutectic, martensite, rimmed steel, seam, solidus). The Institute requests the co-operation of suppliers of oilfield equipment in the elimination of uncertainty and confusion by restricting the use of these terms to their accepted meaning.

The second portion of the Code gives the S.A.E. classification of Steels and Tables showing the range of analysis in carbon steels, free-cutting, manganese, nickel, Ni–Cr, Mo, Cr–Va and tungsten steels; corrosion and heat-resisting alloys. A Table showing the approximate relations between Brinell, Rockwell, and Scleroscope Hardnesses and Tensile Strengths of S.A.E. and Alloy Construction Steels is also included.

THE CRACKING ART IN 1936. G. Egloff, E. E. Crandal and M. M. Doty. Pp. 341. U.O.P. Booklet No. 206. Universal Oil Products Co., 310 So. Michigan Ave., Chicago.

This review, which covers publications from January 1st to December 31st, 1936, gives 421 references to the literature, together with a list of patents. Chapters are included on the following: the world status and economics of cracking, cracking reactions, liquid vapour phase, vapour phase and selective or multiple-coil cracking, cracking equipment, cracking with oxidation, electrical cracking, cracking other than petroleum oils, cracking and polymerization of hydrocarbon oils, alkylation, treating cracked products and by-products of cracking.

SYMPOSIUM ON LUBRICANTS (1937). CHICAGO REGIONAL MEETING OF THE AMERICAN SOCIETY FOR TESTING MATERIALS, MARCH 3RD, 1937. Pp. 89. A.S.T.M. Philadelphia, Pa. $1.25, paper; $1.50, cloth.

The papers and discussion appearing in this volume were presented at a Symposium on Lubricants held at the eighth regional meeting of the A.S.T.M. The papers comprise the following:—

"Engine Deposits—Causes and Effects." W. A. Gruse and C. J. Livingstone.
"Automotive Bearings—Effect of Design and Composition on Lubrication." A. F. Underwood.
"Addition Agents for Motor Oils." G. M. Maverick and R. G. Sloane.
"How to Select a Motor Oil from the Standpoint of the Consumer." W. S. James.

THE BROWN-FIRTH RESEARCH LABORATORIES. Pp. 71. The Laboratories, Princess Street, Sheffield, England.

This illustrated brochure describes the different departments of the Brown-Firth Research Laboratories. The essential work of these laboratories lies in the consideration of scientific and technical problems arising in the operation and development of the various processes used in the steel industry, and in the improvement, modification or utilization of the products of this industry. A list of publications issued from the Laboratories and a catalogue of books and manuscripts contained in the Library are included.

Commonwealth of Australia:

REPORT ON THE ADMINISTRATION OF THE NORTHERN TERRITORY FOR THE YEAR ENDED JUNE 30TH, 1936. Pp. 50. L. F. Johnston, Commonwealth Government Printer, Canberra. 2*s.* 4*d.*

TERRITORY OF PAPUA. ANNUAL REPORT FOR THE YEAR, 1935–1936. Pp. 32. L. F. Johnston. Commonwealth Government Printer, Canberra.

AN INTRODUCTION TO PHYSICAL GEOLOGY WITH SPECIAL REFERENCE TO NORTH AMERICA. W. J. Miller. ix + 465 pp. with 397 diagrams and photographs. Van Nostrand Co., Inc., New York, 1936. Chapman and Hall, London. 15*s.* net.

This book is a second printing of the third edition of a standard American text-book, first published in 1924. It forms a companion volume to the author's "Historical Geology."

New Publication.

ANNALES DE LA SOCIÉTÉ BELGE POUR L'ETUDE DU PÉTROLE. Vol. 1. No. 1. Published by the Society, 3, Rue de Jemappes, Gand, Belgium. Price 5 francs. 10¼ × 8¼ in. Pp. 1–31.

The Société Belge pour l'Etude du Pétrole, de ses Dérivés and Succédanés was established at Brussels on 13th February, 1937. The Officers of the Society are:—President: Prof. P. Erculisse; Vice-President: Maj. I. F. M. Damman; Secretary: Prof. F. Malschaert; Treasurer: P. Lamal. The Registered Address is:—3, Rue de Jemappes, Gand, Belgium.

The first issue of the Society's publication contains (1) A Short Account of the Formation of the Society, (2) A List of Members and (3) its Bye-Laws. There are short reports of five meetings held since the inauguration of the Society, together with the text of the following papers which have been presented:—

"L'Evolution actuelle du Raffinage du Pétrole," by A. de Boulard.
"Où en est la Question du Pétrole en Campine Belge," by S. J. Pirson.
"Graissage des Moteurs à Explosion," by F. Van Lierde.

The two latter papers are accompanied by a discussion.

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Geology.

1269. Geologic Sections in Texas and Adjoining States. W. C. Thompson. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 1083–1087.—These sections (eight in number) are the result of the author's work in various districts of Texas during the past 10 or 12 years. They have been prepared to show the relationship of one district to another and the approximate thickness of the formations in various parts of the State. Nearly all types of accumulations, whether structural or stratigraphical, are included, and also most of the various producing oil and gas horizons.

A brief description of each section is given, special mention being made of their salient features. G. S. S.

1270. Mississippi Oil and Gas Developments. H. N. Toler. *Oil & Gas J.*, 16.9.37, **36** (18), 55–57, 276.—Outcrops ranging in age from Devonian to Recent make it possible to carry out surface mapping in most of the State except the Mississippi delta region. The formations dip and thicken to the W. and S.W. and contain several possible sources of oil and gas. These include horizons such as the Jackson (Eocene), Selma Chalk and Eutaw (Cretaceous), which are productive in other areas. The Palæozoic may also prove productive if structural conditions bring it within drilling range.

Several structures are known in the area and a small amount of geophysical work has been done, but so far information is scanty. A salt dome has been discovered in Lamar Co., and indicates the possibility of a salt basin in the south-central part of the State which will contain a number of these structures. The Jackson gas-field has been developed on a dome which is probably the result of an igneous intrusion. Production is obtained from the Selma Chalk. Several other structures, such as faults, have been drilled, but it will be necessary to carry out considerably more geological and geophysical work before a thorough test of the area can be made.

J. A. G.

1271. Pennsylvanian Basin of West Central Colorado Geologized. H. W. C. Prommel. *Oil & Gas J.*, 23.9.37, **36** (19), 20–21, 24.—Exploratory work in S.W. Colorado and S.E. Utah has determined the approximate limits of the Paradox Geosynclinal Basin. This is bounded on the S.W. by the San Rafael Swell and on the N.E. is separated from the Glenwood Springs Basin by the Uncompahgre Uplift. In the former basin exploratory drilling discovered a petroliferous series of gypsum, anhydrite, salt, shale, and sandstone underlying the Pennsylvanian. The corresponding formations in the Glenwood Springs Basin do not contain the salt beds, and the gypsum series are not so massive. Here the Pennsylvanian is represented by an upper series of sandstones, shales and limestones; the middle series contains lenticular beds of gypsum and anhydrite associated with shales, limestones and sandstones; and the lower member consists of dark shales, sandy limestones and sandstones. Below the Pennsylvanian is an unconformity followed by the Mississippian (Madison limestone), Devonian, Ordovician, and Cambrian, with an unconformity between each series.

Several N.W.–S.E. lines of folding are developed in the basin and a number of anticlines have been discovered on them. To the S.E. the folds merge into faults which show considerable displacement.

A number of probable source-beds are present in the succession, and there are good possibilities of commercial production from several of the sandstone horizons.

J. A. G.

1272. Important New Field Expected in Illinois Basin. A. G. Hillen. *World Petr.*, Aug. 1937, **8** (8), 64.—Results of recent tests and a study of the stratigraphy in the

Southern Illinois basin indicate the possibility of production from several horizons. The Mississippian is represented by a thick series of shales and sandstones overlying the St. Genevieve limestone series. At the close of Mississippian times movement raised the edges of the basin and formed the La Salle anticline. Subsidence continued until after the Pennsylvanian and a thick series of the latter was deposited.

Production is anticipated from two main horizons: lenticular sands at the base of the Pennsylvanian and the Chester Sands in the Mississippian. Accumulation in the latter will largely depend on structural conditions. J. A. G.

1273. Stratigraphy of Northern Extension of Burlington Limestone in Missouri and Iowa. L. R. Laudon. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 1158–1167.—Divided into four sub-series, the Mississippian series of North America consists of the Kinderhook at the base, followed by the Osage, Meramec and the Chester at the top. Recently the term Valmeyer was introduced and defined to include the Osage and Meramec deposits. Such a classification is opposed by the author, who points out that the greatest faunal break in the Mississippian occurs at the top of the Osage sub-series, four divisions of which are commonly recognized. These are the Fern Glen and its equivalents at the base, followed by the Burlington, Keokuk and Warsaw.

The basal Osage beds are easily distinguishable by their faunal assemblages, and it is clear that the faunas migrated from the western seas into the Mississippi Valley province.

The Burlington limestone is much less widely distributed than the underlying basal formations, and it is possible to establish seven definite life zones within it: in N.E. Missouri and S.E. Iowa. There is a transgressive overlap of the sub-divisions of the limestone against the underlying formations towards the north, and each of the life zones from the base upward occurs in contact with underlying beds in the region between Missouri and Kalona, Iowa.

Figures are given showing type sections of the Burlington. G. S. S.

1274. Garh-i-Qaraghuli Oilfield. Anon. *Petr. Times*, 18.9.37, **38** (975), 365.—This field in S. Iran is situated 90 miles north of Bushire and 125 miles S.E. of Haft Kel. It is a fold field, the reservoir rock being jointed and fissured Asmari limestone of moderate porosity overlain by the incompetent Lower Fars. The axis of the structure in the Fars at the surface is not coincident with the axis in the limestone; consequently early wells were drilled down dip. The true axis was located geophysically and confirmed by gas seeps. Drilling started from 1926–30 with cable tools, but the pressures were too great for the equipment, so the exploitation was delayed until late last year. Two new wells gave 33,000 brls./day each, and further wells down dip are being drilled to limit the pay zone. R. O. Y.

1275. Progress of Search for Oil in Australia and Territories. Anon. *Petr. Times*, 11.9.37, **38** (974), 333.—Several wells now drilling have given good shows of gas. At Arcadia, Queensland, the gas contained up to 80% CO_2 in some samples and 26% CH_4, 4% C_2H_6 and higher homologues in others. The old Roma well, closed in since 1931, was opened up, and a column of oil and water was found above the plug at 3412 ft. Tests by Dr. Wade showed that oil and gas were being flushed into the well by water, the quantity of oil being proportional to that of the water. Recent shallow borings show that this well is near the centre of a structural depression, so at present a more favourable location is being sought hopefully.

In Papua and New Guinea test boring has started, and great field activity prevails. In Papua, in the Pinari River area, a thick series of Miocene oil-impregnated silts has been discovered. R. O. Y.

1276. Geological Basis of the Present Search for Oil in Great Britain by the D'Arcy Exploration Company, Ltd. G. M. Lees and P. T. Cox. *Quart. Journ. Geol. Soc.*, 1937, **93** (2), 370, 156–194.—The paper opens with a brief historical summary of the search for oil in Great Britain. For some years the D'Arcy Exploration Company has been carrying out geological investigations throughout the country, and sufficient evidence, including new discoveries of seepages and oil-impregnated rocks, was accumulated to justify a more extensive and systematic search. Advances in geological

geophysical and drilling knowledge and technique were additional favourable factors, and the nationalization of oil rights, by the Petroleum Production Act of 1934, allowed drilling to be considered in the light of a commercial venture.

The prospecting licences granted to the D'Arcy Company in December 1935 cover 6946 square miles, of which 2227 square miles are in the South of England, 4470 square miles in the Midlands, 178 square miles in North-East Yorkshire and 71 square miles in Scotland. The prospects of these areas are not all of equal value, but some are up to the standard required for the average projected oil exploration to-day.

The conditions necessary for the existence of oil source-rocks, and the recognition of source-rocks in the field, are summarized. All organic shale formations, from the Silurian upwards, have been examined, but the final drilling proposals were based on positive evidence of the existence of oil rather than on theoretical considerations.

Small occurrences of bitumen are associated with Ordovician, Silurian and Devonian rocks, but they are not known to have any economic significance. The oldest formation showing numerous and widespread oil indications is the Carboniferous.

The Permian shows evidences of indigenous oil, but not to the extent of the Carboniferous. The Jurassic is particularly rich in oil indications and in potential source-rocks, which appear to be responsible, also, for the oil occurring in the Wealden sands.

The potentially important Upper Palæozoic and Mesozoic oil prospects are described in detail.

New discoveries of rich oil-impregnation were made first at Worbarrow Bay, and subsequently in all Wealden exposures between this place and Dungy Head.

The exploration programme covers the testing of Carboniferous, Permian, and Jurassic and Wealden beds.

The evidence of oil shows in the outcropping Carboniferous limestone of the Pennines and in the coal workings is as impressive as that at the surface in the Mid-Continental oilfields of the United States. The failure of the 1918–22 drilling campaign in the Pennine area is probably due to insufficient closure to the west in the anticlines tested, together with low fissure frequency in the limestone. Attention is now concentrated on the country east of the Trent, where the possibility of a broad anticlinal zone, similar to that of the exposed Pennine uplift, but from which the cover of the Coal Measures was not denuded during the pre-Permian erosion, offers an oil prospect.

To test the Permian limestone for an oil accumulation, it is proposed to drill about a mile west of Aislaby, near the crest of the Eskdale dome.

The Jurassic and Wealden beds have been tested by wells at Portsdown and Henfield. These sites were chosen on account of the attractive size and unbroken nature of the anticlines at these points, but the wells have explored the entire Jurassic sequence without encountering any commercially important oil or gas shows. Porosity in the cored beds never exceeded 5%, which may explain the negative results of both borings.

The Kingsclere anticline in Northern Hampshire and the Poxwell fold in Dorset have been chosen for the next tests.

A detailed account of the data revealed in the Portsdown and Henfield bores is given; it includes lithology, temperature measurements, oil, gas and water shows, and structural deductions. About 30% of the formations penetrated at Portsdown were cored.

The geophysical investigations in Nottinghamshire, Lincolnshire and Yorkshire are described.

The results obtained by shallow boring at Pevensey and Lewes, and at Kingsclere and Ham, are summarized.

A bibliography is included, and an appendix describes the fossils recovered from the Henfield boring. L. O.

1277. Stratigraphical and Structural Distribution of Petroleum in Britain. E. H. Cunningham Craig. *Petr. Times*, 28.8.37, **38** (972), 259–261 and 276–278.—Petroleum indications are common in our stratigraphic column, but lateral variation may lead to misleading results. Geological mapping has been thorough, but not undertaken from the oil standpoint; therefore old data should be reconsidered rather than new sought, except where geophysics may be used to seek buried structures. The oil prospects begin in the Carboniferous, which is well represented. In Scotland oil

shales are well developed, and the author regards them as colloidal inorganic matter with inspissated petroleum; consequently a study of their extent and richness should be a guide to prospecting. In England oil indications almost exclusively occur in the Coal Measures and Millstone Grit series. Owing to the extensive erosion if favourable structures remain, they must be sought geophysically, as only the coal basins remain at the present time in many cases. Prospects are better in S. Scotland on the Cousland–D'Arcy anticline.

In both the Jurassic and Lower Cretaceous oil indications exist, but prospects are poor. In the Jurassic possible reservoirs exist in S. England, but big structures are lacking. In the Lower Cretaceous good reservoirs exist for Jurassic oil, but the main Wealden structure is denuded, and only minor closed structures may exist.

Undoubtedly there is abundant evidence of former oil in Britain, but denudation has dissipated major accumulations. R. O. Y.

1278. Stratigraphic Comparison of Polish Crude Oils. C. Bohdanowicz. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 1182–1192.—In this paper an attempt is made to arrive at an approximate comparative classification of crudes according to stratigraphic horizons and depths of occurrences in various oil-fields of Poland.

Tables are given showing the variation in specific gravity, paraffin-content and residue cold test of crudes from different horizons in various fields.

The following types of crude may be distinguished: Krosno series, which contains a light asphalt-base crude; Menilite series, paraffin base crudes; Eocene, light and heavier asphalt-base crudes; Cretaceous (including Jamna horizons), asphalt-base types.

Variations occur in crudes of the same chemical type, but these are not such as to prevent their classification. G. S. S.

Geophysics.

1279. Geologic Significance of a Geothermal Gradient Curve. W. B. Lang. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 1193–1205.—A subnormal temperature condition exists in the Permian basin. Tests were made in the 6683-ft. Getty-Dooley well No. 7 in Eddy County, New Mexico, which had stood for 5 months practically full of water. There the Permian rocks are almost horizontal, and undisturbed by folding or faulting. The Rustler formation extends to 360 ft.; Salado halite to 1026 ft.; Carlsbad and Capitan reef limestones to 3823 ft.; Delaware Mountain sandstone to 6266 ft.; Bone Spring limestone. The temperature gradient increases with depth, and the curve shows evidence of three parts corresponding to the major lithological units. The lowest gradient is in the halite and anhydrite group of rocks, which have the highest thermal conductivity; the limestone shows a higher gradient and the sandstone a still higher gradient. Thus it seems possible to measure the thermal conductivity of rocks in situ.

No appropriate data are available to show the effect on the conductivity of rocks of varying amounts of water, of salts in solution, or of oils and gases. Solution of the Salado formation, transformation of anhydrite to gypsum, the presence of igneous intrusions and the radioactivity of potassium in the rocks, all seem incapable of explaining the form of the geothermal gradient curve. Hence its characteristics must be due to the different conductivities of the successive layers of rock. G. D. H.

1280. Ultimate Precision of Barometric Surveying. V. Vacquier. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 1168–1181.—The development of more precise aneroid barometers is of interest to those engaged in gravimetric prospecting. Two experimental barometers have been constructed by the Gulf Research and Development Company which will read to 0·2 ft. in elevations, and their general design renders instrument errors small. These instruments are supported on light tripods and are carefully levelled.

Tests were carried out in country such as is suitable for gravimetric surveys. The base operator read the pressure every two minutes and also measured the temperature and humidity frequently. The field observer returned to the base three times daily so as to eliminate instrumental drift. The probable error of a single observation

due to instrumental inaccuracies was found to be 0·3 ft. The errors of atmospheric origin were due to pressure fluctuations of a random nature, and they could not be calculated from general meteorological data. Under average weather conditions and a separation of 3 mls., the contribution of atmospheric disturbances to the probable error of a single observation was only 0·96 ft.

The experience shows that it is not difficult to devise a barometric system with three times as great a precision. G. D. H.

1281. Probe Electrode. A. J. P. Walters. *Mining Magazine*, Sept. 1937, **57** (3), 148–157.—It is claimed, as a result of laboratory and field investigations, that the steel probe is more efficient and sensitive than the stake electrode in earth-resistivity measurements, and that the probe can also function with greater advantage in any other electrical method involving the use of metal electrodes. Its employment minimizes the masking effects of the overburden and purely surface anomalies. D. W.

1282. Magnetometric Survey in the Lincolnshire Iron Field. K. H. Waters. *Mining Magazine*, June 1937, **56** (6), 341–345.—Describes the results of an experimental survey with the Schmidt vertical field magnetometer over paramagnetic bedded Jurassic iron ores near Lincoln. Despite the comparatively unresponsive nature of the ore and the presence of many disturbing influences, such as steel rails and random iron objects, the slight magnetic variations recorded were sufficient to indicate broadly the position of the unexploited ironstone. D. W.

1283. British Drilling Progress. Anon. *Petr. Times*, 28.8.37, 272; 11.9.37, 339; 25.9.37, 400–401.—The shallow geological test at Broad Bench, Kimmeridge Bay, has been abandoned at 942 ft. for the present, having given the required information. The D'Arcy Exploration Co. have been carrying out an extensive torsion balance survey in Yorkshire and Lincolnshire. They have had recourse to magnetometer, gravimetric and seismic refraction methods, but are not yet able to interpret results clearly with any certainty. The same company has commenced drilling in Midlothian on the N. flank of the Cousland–D'Arcy anticline, while their Kingsclere and Eakdale wells continue in Corallian and Lias, respectively. The Hellingley well was abandoned in Carboniferous, which lay unconformably below the Jurassic. In the Portland Sands and Corallian, porosity was quite lacking, and these were poorly represented. The next Anglo-American Co. well will be only 100 yds. from the old D'Arcy well near Dalkeith, where fair oil shows were obtained. R. O. Y.

1284. Interesting Roumanian Structures Under Test. Anon. *Petr. Times*, 28.8.37, 38 (972), 269–270.—At the end of July a modification of the New Mining Law was made awarding companies 2500 ha., instead of 300 ha., for exploring wildcat territory. This should stimulate exploration, which has been on the wane. The considerable fall of 19% in production for Jan.–June 1937 compared with Jan.–June 1936, in spite of increased footage, has caused alarm. Apart from numerous exploration failures, this is partly due to the rapid and unexpected decline of Bucsani, despite great drilling activity. The decline would have been worse but for the steadiness of the Boldesti–Harsa group of fields, where a new well at Paulesti, on the western extension of the structure, gave an initial production of 450 tons/day.

Apart from geological and geophysical exploration, several new structures are being tested. At Manesti high-pressure gas was found in the crestal region, and drilling down dip is in progress. The Suta Seaca anticline, found by geophysics, is being tested. Txintea holds good hopes of Meotic production, but steep dips and high gas pressures have hindered progress. Exploration at Podeni Noi and Pacureti goes on still, and the latter area seems very promising. R. O. Y.

Drilling.

1285. Unitized Rotary Rig of Improved Design for Deep Drilling. W. A. Sawdon. *Petr. Eng.*, Sept. 1937, **8** (13), 44.—A unitized rotary drilling base assembly in opera-

tion in the El Segundo field, California, has resulted in a high degree of portability, combined with ease and speed in rigging-up.

Each unit of the drilling base assembly consists of the structural steel base and the equipment that the base supports. Even the walks and steps are made of steel and are portable.

Built into the sub-base and forming a permanent part of the unit are all steam piping and connections to the equipment that it serves. A steam scrubber for the vertical steam engine power driving the draw-works is also built into the sub-base.

The engine for the main draw-works and its sub-base constitute one unit; in rigging-up it is connected to the draw-works unit by two structural steel members bolted to the upper members of the two units.

The third unit is composed of the rotary table, whilst the fourth sub-base supports a Hydril draw-works, with sand reel and a vertical twin steam engine. L. V. W. C.

1286. Modern Steam Rig that Approaches Power-Plant Efficiency. M. L. Cashion. *Petr. Eng.*, Sept. 1937, **8** (13), 41.—One of the most efficient and economical steam drilling rigs yet designed is in operation in the shallow Timberlier Bay, Louisiana.

Preparatory to rigging-up, the bay was dredged to form a channel to the well site and piles were then sunk 60 ft. deep and the entire layout, with the exception of the boilers, was mounted on this storm-proof piling foundation.

The two boilers are mounted on a floating barge lashed to eight 5-tie pilings. The steam line is fitted with ball joints to allow the boiler barge complete freedom of movement.

The equipment used is the most modern possible, the table being driven by a separate engine from that which drives the draw-works, and the slush pump is separately driven also.

Six features may be said to be responsible for the economical working of this rig: (1) Automatic control, (2) dutch ovens under boilers and superheaters, (3) fully insulated boilers and steam lines, (4) superheated steam, (5) reciprocating engines operated with cut-off control, and (6) condenser, which reduces back pressure in the engines and returns heat and clear water to the boilers. L. V. W. C.

1287. Wildcat Drilling in 1935 and 1936. F. H. Lahee. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 1079–1082.—An investigation of the results of wildcat drilling in the Gulf Coastal Plain shows that of all holes drilled in 1935, 7·32% were successful and 92·68% were dry, and in 1936 the figures were 10·67% and 89·33%, respectively. It is not thought that the success in the latter year was due to improved technique, but more probably to chance. To check these results more closely, it is recommended that a similar study of wildcat drilling should be made over a period of previous years, and that an analysis of this kind should take place annually.

Maps and tables accompany the report. G. S. S.

1288. Longest, Heaviest String of 7⅝-in. Casing Ever Run. F. L. Singleton. *Oil & Gas J.*, 2.9.37, **36** (16), 25.—The longest and heaviest string of 7⅝-in. casing ever run was successfully cemented recently in the Coastal Louisiana area.

The casing was cemented on bottom at 11,342 ft. in the record time of 14 hours. This casing was cemented without difficulty in the greatest amount of open hole on record. This well marks another step in the advancement of deeper exploration, and is an especially interesting achievement in mud-conditioning and drilling.

The amount of open hole was 9167 ft. and the casing string was made up of 4000 ft. of 7⅝-in. external upset casing and 7342 ft. of 34-lb. threaded casing on top, making a total load of 421,628 lb. L. V. W. C.

1289. Diamond Core Bit Used in Drilling Strata in Arkansas. M. Tucker. *Oil & Gas J.*, 9.9.37, **36** (17), 46.—The most successful means of penetrating hard metamorphic formations in a wildcat well being drilled in Arkansas has been found to be by black diamonds. This is one of the few production wells drilled with diamonds and the only one being so drilled to-day.

This hole was originally drilled with a light duty steam rotary and rock bits, but

after six months' operation only 788 ft. of hole had been made and several fishing jobs had resulted due to the hardness of the formation.

A Sullivan diamond drill outfit was then installed and a hole $2\frac{7}{32}$ in. in diameter was made. Eight large Brazilian black diamonds are set in a head of soft Swedish steel, each diamond costing about $300, and four small stones, costing about $100 each, are set on the sides of the bits to keep the hole to gauge.

Weight ranges of 4000 to 8000 lb. have been tried with normal speeds of from 100 to 150 r.p.m. The cutting speed is from 18 to 22 in. per hour.

L. V. W. C.

1290. New Method for Taking Core Samples at Well. L. S. Panyity. *Oil & Gas J.*, 2.9.37, **36** (16), 46.—In order to prevent loss of oil from cores, it is suggested that the rock samples should be retorted at the wells immediately they are brought to the surface. In this way the samples are not handled until after the saturation test is completed.

The design of the retort used is described as well as the method of using it.

L. V. W. C.

1291. Economy of Maintaining a Vertical Hole. S. A. Wallace. *Petr. Eng.*, Sept. 1937, **8** (13), 186.—The limiting of the maximum allowable deviation and the checking of the inclination of the hole at frequent intervals during drilling enable increases in drilling speed to be attained and aids in improved well completion.

Obtaining accurate information during drilling enables the technique and methods to be used to be formulated.

The fastest drilling can be accomplished by a proper co-ordination of weight, speed and pressure under the conditions encountered. L. V. W. C.

1292. Life of Stripper Wells Extended through Improved Efficiency. M. Tucker. *Oil & Gas J.*, 26.8.37, **36** (15), 56.—Stripper properties are now being looked upon with increasing favour and are being improved, new equipment is being installed where justified, and their economic life extended.

Adequate data are now available to enable accurate decisions as to whether or not to apply certain types of artificial production methods to be made. This applies to water drive or repressuring schemes.

Another important development is the drilling of new inside wells to tap the oil lost at the time the reservoir energy was rapidly dissipated.

Reconditioning of old wells and the checking of oil and water levels have added to the profits that can be made from these wells. L. V. W. C.

1293. Heavier Drilling Equipment Aids Development in West Texas. N. Williams. *Oil & Gas J.*, 26.8.37, **36** (15), 63.—The speeding up of exploration and drilling in West Texas has been assisted by the advent of newer and heavier types of equipment. While cable tools are still being used in some places, modern rotary rigs are finding increasing usage.

Pressure drilling is making it possible for drilling-in with rotaries using oil for drilling fluid, and the faster speeds possible with rotary drilling have resulted in expediting development.

Greater control over formation conditions and natural hazards is possible with the heavier and more adequate equipment and facilities in drilling and completion.

The increasing application of geophysics is also facilitating development and the opening of additional reserves in the district. L. V. W. C.

1294. Compactness of Design Feature of Louisiana Unitized Rotary. M. Tucker. *Oil & Gas J.*, 2.9.37, **36** (16), 45.—A new design of portable and unitized rotary, having a maximum rated capacity of 4500 ft., with two 110 h.p. gas or gasoline motors, has been developed in the Louisiana district. Light weight and compactness of design are the principal features presented.

By the substitution of 150 h.p. motors the maximum drilling depth can be extended to 5500 ft. in hard drilling formations.

The unit consists of motors, clutches, and draw-works mounted on one set of skids. The rotary table is chain-driven either from single or compounded motors, whilst the slush pump is driven off the clutch pulley from one motor and can be compounded to operate off both motors if desired.

The motors are equipped to utilize either gas or gasoline. L. V. W. C.

1295. Hard Formations in Louisiana Affect Drilling Practices. M. Tucker. *Oil & Gas J.*, 19.8.37, **36** (14), 44.—The drilling of wells in the northern Louisiana area is presenting many problems. The average drilling time to the 8100 ft. level is from 80 to 100 days and requires 60 to 80 rock bits.

The determination of the correct rotating speeds, bit weights, number of drilling lines, make-up of drill steam, etc., is being made, and since some of the factors are diametrically opposed, whilst some vary from one formation to another, a compromise must be made in some to obtain an overall advantage from the others if maximum results are to be realized.

The heaviest and most modern equipment is standard in this area. Derricks are 136 ft. with substructures, and 14 × 14 in. steam drilling engines, 9 in. draw-works shaft, 15½ × 8½ × 20 in. slush pumps are used throughout. Rock bits are used from the surface down. The production string is 7 in. O.D. to bottom and the commencing hole is 18½ in. or 17½ in.

The final 2300 ft. of hole requires from 60 to 75 days to drill and from 50 to 80 8½ in. rock bits are used. L. V. W. C.

1296. Notes on Development Practice in Southern Illinois Basin Fields. J. C. Albright. *Petr. Eng.*, Sept. 1937, **8** (13), 176.—Modern rotary rigs have replaced the cable tools used at the discovery wells in the Illinois basin area.

Water is difficult to obtain in the southern portion at certain seasons of the year from surface ponds and creeks, and shallow wells do not provide a sufficient supply for an extensive programme if many wells are drilled near each other at one time. A Schlumberger survey located a fresh-water stratum about 40 ft. thick at between 300 ft. and 350 ft. from the surface, and if the volumes of water are large, drilling can be carried on without interruption throughout the year.

Weights on the bit and mud circulation similar to those used in the Mid-Continent can be employed. Weights carried average between 6 and 8 points and speeds average between 90 and 100 r.p.m. L. V. W. C.

1297. Drilling Patents. A. L. Armentrout and E. B. Hall. U.S.P. 2,092,041, 7.9.37. Apparatus for sealing-off the strata in a well, consisting of an integral drillable tubular member closed at its lower end, having ports longitudinally spaced and a tubular basket surrounding the member to receive cement.

A. L. Armentrout and E. B. Hall. U.S.P. 2,092,042, 7.9.37. Well screen.

C. C. Brown. U.S.P. 2,092,048, 7.9.37. Packer setting device.

W. G. Lane. U.S.P. 2,092,316, 7.9.37. Oil-well fishing magnet.

C. L. Henry. U.S.P. 2,092,511, 7.9.37. Steel substructure for oil-well derricks.

A. M. West. U.S.P. 2,092,822, 14.9.37. Removable back pressure valve.

R. K. Henderson. U.S.P. 2,092,843, 14.9.37. Packer and means for securing it in the casing.

M. O. Johnston. U.S.P. 2,093,129, 14.9.37. Well packer.

F. Ellingsen. U.S.P. 2,093,603, 21.9.37. Well reamer.

J. H. Howard and A. C. Catland. U.S.P. 2,093,607, 21.9.37. Rock core drill head.

A. C. Catland. U.S.P. 2,093,632, 21.9.37. Well reamer.

A. C. Catland. U.S.P. 2,093,633, 21.9.37. Core drill.

L. E. Vaughn. U.S.P. 2,093,788, 21.9.37. Pipe tongs.

A. S. Baptie. U.S.P. 2,093,794, 21.9.37. Jar for electric device.

E. S. Moore. U.S.P. 2,094,200, 28.9.37. Platform for derricks.

L. V. W. C.

Production.

1298. Plugging Back May Make Smackover Wells Profitable. B. Mills. *Oil Weekly*, 13.9.37, **87** (1), 17.—An attempt to increase production of oil in old wells of the Smackover area by the location of more favourable producing levels is being made by plugging back from the deeper formations.

A surveying programme has been started to determine the condition of the troublesome wells. Deviation from the vertical is being checked as an aid in plugging-back operations.

Electrical logging and coring devices for determining the nature of the formations behind the casing have proved helpful, and the running of these instruments has been an important part of the preliminary programme.

The methods to be generally favoured in plugging back wells will be those that permit the placing of cement at the desired levels. L. V. W. C.

1299. Electric Power Required for Pumping Oil Wells. W. H. Stueve. *Petr. Eng.*, Sept. 1937, **8** (13), 48.—The results of an investigation of oil-well pumping operations indicate the relative efficiencies of different pumping methods and how depth influences electric power requirements.

It is concluded that the best average pumping efficiency obtainable from beam pumps is approximately 35%, whilst the efficiency of central powers is slightly higher, but cannot be improved on. The hydraulic-actuated pump has the greatest efficiency of any studied, but volumes greater than 400 to 700 brls. from depths of 6500 ft. cannot be handled. L. V. W. C.

1300. Eliminating One Problem of Pumping Heavy Oils By Using A Special Hook-up. C. C. Herman. *Oil Weekly*, 4.10.37, **87** (4), 28.—The difficulties experienced in pumping heavy oil, such as transmission oil, can be eliminated by the use of a special hook-up, which is described.

The oil must be heated to a temperature of about 60° F., and provided the pump is in good condition and all air has been removed, the oil can be moved throughout the year. L. V. W. C.

1301. Wet Gas Measurement and Control Problems. H. F. Chapman. *Oil Weekly*, 4.10.37, **87** (4), 24.—Many problems arise in the measurement of wet gas, and among the more common may be mentioned: improper installation, pulsating flows, oily or wet gas, leaks in meter and meter piping, surging flows, deduction meters and sour gas. These troubles are dealt with in some detail by the author. L. V. W. C.

1302. Variety of Water-Flooding Methods Used in South Kansas Projects. P. Reed. *Oil & Gas J.*, 2.9.37, **36** (16), 40.—The present development of water-flooding practices adopted in the Mid-Continent area follows two years of extensive studies of the possibilities of the shoestring sands in this area for flooding.

Core analysis showed that permeability is commonly found to range from 20 to over 100 millidarcys, and average oil content between 500 and 600 lb. per acre-foot have been reported.

Six active flooding projects have been started in the area from Anderson and Linn to Crawford County. Most of the projects have from 7 to 11 wells, and the usual practice in planning is to adhere to a well pattern which is either a true 330 ft. 5 spot or a modification of it with 250–300 ft. spacing. Water intake wells are equipped with tubing cemented on the sand in most cases.

On certain properties delayed flooding is practised. L. V. W. C.

1303. Corrosion Problems of Western Kansas Increasing with Water Encroachment. F. B. Taylor. *Oil Weekly*, 4.10.37, **87** (4), 17.—The prevention of corrosion is more valuable to the operator than the cure after the corrosion has done its work. Water encroachment in the West Kansas area is increasing and indications are that it will become more of a problem as time goes on.

The author deals with some of the means devised to combat, or retard, corrosion in this region. The effect of corrosion on the material in the well and on the lease is related, and the means employed to cut down the costs of replacements on tubing, casing, rods, lines and tanks as a result of attacks by brine, hydrogen sulphide and other agents are given. L. V. W. C.

1304. Water Withdrawal Rates Influence East Texas Pressure. S. A. Guiberson, Jr. *Oil Weekly*, 27.9.37, **87** (3), 17.—The dissipation of water drive energy in the East Texas field is believed to be just as important as the dissipation of gas energy, and the production of a barrel of water to have the same influence on bottom-hole pressure as the production of a barrel of oil.

The volume of water being produced in the field is increasing and this is viewed as an increasing danger. It is suggested, therefore, that the proration rules for the field should take this factor into consideration by establishing regulations governing the production of water as well as of oil. L. V. W. C.

1305. Gas-Lift and Flow Operations in Corpus Christi Pool. S. F. Shaw. *Oil & Gas J.*, 9.9.37, **36** (17), 43.—The discovery well in the Corpus Christi pool was completed on 2nd November, 1935, and the number of wells drilled to January 1937 was 207 oil wells, 3 gas wells and 12 dry holes. Many of these wells have been completed by landing the casing at the bottom of the hole and perforating the casing at the supposedly most favourable horizon. The spacing in parts of the field has been too close from an economic standpoint.

The size of the oil strings employed has affected the production, and to recover the oil now being produced the operation consists in lifting large quantities of water, from 1000 to 3000 brls. per day, and these large quantities can be lifted only by continuous gas-lift or by submerged centrifugal pumps.

The decline in pressure in the pool has been very rapid due to the comparatively large volumes of gas produced per barrel. Water encroachment has been rapid, but this has tended to maintain the pressure somewhat even with the modest quantity of oil that has been produced per acre. Systematic production of oil has been difficult, and the method of production has been to allow the wells to produce naturally as long as possible, and then to put them on gas-lift when the amount of gas produced was insufficient to do the work efficiently. L. V. W. C.

1306. Production Patents. E. P. Halliburton. U.S.P. 2,092,062, 7.9.37. Apparatus for testing oil wells.

L. L. Rector. U.S.P. 2,092,261, 7.9.37. Tubing-head.

G. F. Turechek. U.S.P. 2,092,294, 7.9.37. A gun unit for gun type well casing perforators.

W. G. Lane. U.S.P. 2,092,317, 7.9.37. An explosive cartridge for gun perforators.

L. Spencer. U.S.P. 2,092,337, 7.9.37. Formation testing apparatus.

L. O. Koen. U.S.P. 2,093,609, 21.9.37. Well fluid-lifting apparatus including a pressure fluid inlet valve, a liquid inlet valve, a conductor connecting with these valves for receiving fluid and liquid therefrom, and means whereby the valves may be opened and closed and the actuating element removed to the surface when desired.

A. B. Germany. U.S.P. 2,094,169, 28.9.37. Tubing cleaner and sucker rod protector. L. V. W. C.

Transport and Storage.

1307. Automatic Valves Used on Gas Line Bridge Crossing. F. E. Reed. *Oil & Gas J.*, 9.9.37, **36** (17), 44.—The engineers of the gas department of the B.C. Electric Power & Gas Co. had a somewhat unusual gas distribution problem in supplying gas to N. Vancouver, a city separated from the gas works by a body of water which is nearly 3 miles across at its widest point and 3000 ft. at its narrowest.

At this narrow part a bridge has been built, but at this point there is a tidal current which runs at times as fast as 10 knots.

The problem of laying an underwater gas main was considered, but in view of the difficulties from the effects of moving sand and silt, it was decided to use the bridge. This bridge has a lifting span, and at the end-joints of this span automatic joints have been used.

When the bridge span lifts for the passage of a vessel, the joints come apart and the gas supply to the city is automatically cut off. The supply to the consumer is protected at this time by storage. When the bridge span is brought to the level again, the joints automatically couple themselves, opening valves and permitting gas to flow. L. V. W. C.

1308. Maintenance of Gas Regulators. E. C. McAninch. *Refiner*, 1937, **16** (8), 373.—Long-distance transmission of natural gas and its subsequent economic distribution place a major responsibility on gas regulators. Fortunately they do not require exceptional attention, but should be inspected at least once a year, or more frequently if conditions of operation so dictate. Assuming the correct regulator has been installed, troubles confronting those responsible for their maintenance usually find their source in improperly-fitting valves and seats, due to the abrasive action of foreign substances, binding of some of the working parts due to misalignment, wrong size of head, loose connections and mechanical effects such as pulsation, or pumping or freezing. G. R. N.

1309. Economics of Investments for Storage of Light Ends. W. B. Franklin. *Refiner*, 1937, **16** (6), 277.—Vapour evolution from pressure and refrigerated storage tanks used for storage of volatile hydrocarbons is discussed. It is demonstrated that the quantity of vapour evolved from refrigerated tankage is proportional to the amount of butane stored, and is independent of the quantity of admixed base stock for casing-head gasolines of high vapour pressure. Comparisons of investments for storage in pressure and refrigerated tankage show that the latter is more desirable when no additional labour is required for operation of the compressor plant. In highly active service, pressure storage is, in general, more economical. It is shown that seasonal storage of butane appears profitable for any type of tankage when a price differential of \$1·5 per brl. (\$2 per brl. as gasoline less \$0·5 per brl. as fuel) can be realized, and in certain situations seasonal storage should prove profitable for much lower price differentials. Economics of investments for seasonal butane storage have been compared with the cost of additional vapour-recovery facilities. Plants, operating at butane recoveries in excess of 50%, which can realize on additional recovered butane for only a fraction of a year, may profit by providing storage for excess summer butane production to meet the seasonal demand, rather than by increasing vapour recovery facilities. G. R. N.

Gas.

1310. Liquid-Level Indicator Set-Ups. P. B. Shannon. *Refiner*, 1937, **16** (8), 389.—Sixteen varieties of well-type manometers suitable for indicating the level of liquid in open or closed tanks are simply illustrated and described. G. R. N.

1311. Patents on Gas. Studien und Verwertungsges. mit Beschränkter Haftung. E.P. 469,933, 30.7.37. Desulphurizing gases containing CO and H_2 in two stages: firstly, passing the gases at 300° C. over a catalyst to decompose the bulk of the organic sulphur compounds, followed by removal of H_2S at a reduced temperature; secondly, removal of the residual sulphur by contacting the gas below 300° C. with sulphur-absorbing masses, *e.g.* alkali metals and oxides or hydroxides of iron. W. S. E. C.

Crude Petroleum.

1312. Microscopical Examination of Crude Petroleum. J. McC. Sanders. *J.I.P.T.*, 1937, **23**, 525–573.—A very extensive account of the special apparatus and technique employed to examine a number of crude oils from Mexico and Rumania in order to determine whether they contained vestiges of those organisms which may have been the parent substances. Thirty references. G. R. N.

1313. Processing of Sulphurous Iraq Crude. M. Morgenstern. *Petr. Z.*, 1.10.37, **33** (39), 31.—S content of distillates is reduced by initial treatment with 0·07 to 0·15% S in presence of 5 to 10 times that quantity of 25% caustic soda solution. J. W. J.

Cracking.

1314. Combination Selective Cracking. E. R. Smoley, V. Mekler and A. H. Schutte. *Refiner*, 1937, **16** (6), 288.—A review of the literature of cracking petroleum and practical operating experience indicates that selection of stocks according to boiling range and according to refractivity permits operation of cracking coil outlets at higher temperatures. This increases crack per pass, octane number of gasoline production and decreases the installation and operating costs of the unit. The relationship between design features, such as conversion per pass, soaking time, and optimum operating conditions for various stocks, is discussed. Flow sheets for three modern combination selective cracking units of capacities from 8000 to 22,000 brls. per operating day of crude charge are presented. These units possess novel features and combine selective cracking according to both boiling range and refractivity of stocks. Operating data for a four-coil selective cracking unit are presented for three different sets of conditions and two types of crude. Typical arrangement of equipment for one of these units is discussed. A new type of heater is described which combines novel features. These permit control of the heating curve by using independently fired heating and soaking sections. Uniform heat transfer rates are attained by removing the products of combustion over the entire roof area and controlling their velocity over the surfaces of the upper radiant tubes. These heaters are diagrammatically illustrated and performance data are given. G. R. N.

1315. Patents on Cracking. G. W. Johnson. E.P. 469,101, 20.7.37. Improved steel apparatus consisting entirely or partly of chromium steel for the thermal conversion of hydrocarbons.

Universal Oil Products Co. and C. H. Angell. E.P. 470,035, 9.8.37. Cracking in which a selected fraction (gasoline) is supplied from the fractionation of the cracking stage to reforming treatment at a higher cracking temperature and the final motor fuel is isolated from the products obtained by this treatment.

E. A. Ocon. U.S.P. 2,088,756, 3.8.37. Vapour purification (desulphurizing) of hydrocarbon oils followed by cracking in two coils.

E. A. Ocon. U.S.P. 2,089,292, 10.8.37. Dual two-stage cracking apparatus for petroleum oils in which the furnace is divided into two sections.

R. H. McKee. U.S.P. 2,089,616, 10.8.37. Hydrogenation and cracking of hydrocarbon oils, conversion or cracking effected by means of steam superheated to about 2000° F., and hydrogenation effected by dissociation of water into its elements.

R. K. Stratford. U.S.P. 2,091,892, 31.8.37. Refining of cracked spirit using clay.

E. A. Ocon. U.S.P. 2,093,571, 21.9.37. Cracking of hydrocarbon oils in which the oil is first desulphurized. The vapours are commingled with sulphur-absorbent material, *e.g.* triethanolamine or ammonia, followed by a catalyst consisting of oxides of Ni, W, Cr, etc.

R. H. McKee. U.S.P. 2,093,843, 21.9.37. Production of motor fuel by subjecting liquid petroleum oil containing unsaturated hydrocarbons to non-destructive hydrogenation and then cracking the saturated hydrogenated liquid oil.

W. A. Lazier and J. V. Vaughan. U.S.P. 2,094,128, 28.9.37. Cracking of hydrocarbon oil-using a catalyst, *e.g.* chromium sulphomolybdate. W. S. E. C.

Hydrogenation.

1316. Patents on Hydrogenation. E. V. Pongratz and A. Immel. U.S.P. 2,091,831, 31.8.37. Destructive hydrogenation of tars, oils, etc., at 300–700° C. and above 20 atm. pressure, using as catalyst a hydrocarbon oil-soluble molybdenum salt of a naphthenic acid. W. S. E. C.

Polymerization.

1317. Patents on Polymerization. C. R. Wagner. U.S.P. 2,088,823–2,088,824, 3.8.37, and 2,088,886–2,088,887, 3.8.37. Polymerization of gaseous olefines to produce motor fuel.

D. R. Stevens and W. A. Cruse. U.S.P. 2,090,905, 24.8.37. Olefines are polymerized by contacting them with a mixture of phenol and sulphuric acid (80–100% strength), together with glycerin.

R. C. Osterstrom. U.S.P. 2,090,333, 17.8.37, F. W. Sullivan, Jr., and V. Voorhees. U.S.P. 2,091,398–2,091,399, 31.8.37. Production of lubricating oil by the polymerization of cracked products and treating the polymers obtained with aluminium chloride at elevated temperatures. W. S. E. C.

Refining and Refinery Plant.

1318. Refinements in Sweetening Technique. J. A. Altshuler and F. G. Graves. *Refiner*, 1937, **16** (6), 272.—The losses occurring in the sweetening of gasolines are discussed in detail, their cost to the industry evaluated and the steps that have been taken to overcome these losses outlined. The largest saving in chemical costs was effected in doctor sweetening when regeneration of the spent chemicals was adopted. Where this process is efficiently practised, further potential savings in this item alone are insufficient to justify additional expensive research work or plant modification. The main losses in present doctor-treating operations are those of gasoline and knock rating, with resulting increase in cost to maintain knock rating specifications. The unavoidable addition of excess free sulphur with its attendant detrimental effect on specifications and inhibitor susceptibility, result in further unnecessary processing cost. These factors fully justify improvements in the sweetening operation. The Stratco lead sulphide process sweetens by catalytic oxidation using air for the oxidizing agent. The catalyst is a suspension of lead sulphide in strong caustic-soda solution. Since the process is catalytic, the chemical consumption is minimized—being due solely to mechanical losses and that small quantity required to maintain the catalyst at its maximum effectiveness. Operating continuously in a closed system without "blackstrap" emulsions, gasoline losses are negligible. Previous over-treatment and production of poor copper-strip test stock, necessitating re-treatment, are eliminated because no free sulphur is used. Knock-rating losses are reduced to a minimum. G. R. N.

1319. Sweetening System Operating on Stabilizer Pressure. R. E. Lege. *Refiner*, 1937, **16** (7), 327.—Unrefined straight-run gasoline at the Southport Petroleum Co., Texas refinery leaves the stabilization unit at a pressure of 200 lb. This is of sufficient magnitude to carry it through the sweetening unit to finished gasoline storage without the use of pumps. The treating plant consists of a caustic scrubber, pressure control valve, a sulphur pot, mixers for contacting the doctor and gasoline, a water wash settler and a sodium sulphite scrubber. A jet valve in the stabilizer line is used to control the degree of mixing of caustic and gasoline, whilst the pressure-control valve is located between the caustic scrubber and the doctor contactors. It is claimed that the unit is flexible and economical in losses, chemicals and power costs. G. R. N.

1320. Improvements in Gasoline Plants. J. C. Albright. *Refiner*, 1937, **16** (7), 338.—In the South Burbank field, Oklahoma, the programme of pressure maintenance on the pool has resulted in a lowering of the gasoline content of the natural gas. The high-pressure gasoline plants of the fractionation type originally installed have therefore been modified to operate as high-pressure absorption plants. Details of the modifications are given. G. R. N.

1321. Refining and Recovery of Light Motor Fuels. H. Naphtali. *Refiner*, 1937, **16** (5), 224.—Two low-temperature processes are described the one for the recovery of motor benzol from crude benzol and the other for the recovery of light gasoline from petroleum gases. In the former process crude benzol is cooled until crystals of benzol separate; these are removed in a centrifuge and washed in situ with dilute alcohol, melted and removed. Final purification of the crystalline benzol is effected by rectification. Since the process is entirely physical none of the by-products are destroyed. In the second process the raw gas is compressed, and the light gasoline is condensed in series coolers, collected and rectified. Low temperatures are attained by utilizing the cooling effect produced by expansion of the gas. G. R. N.

1322. Handling Light Oils, Gasolines and Naphthas. L. C. Trescott. *Refiner*, 1937, **16** (5), 199.—A short discussion on the inter-refinery transfers of light distillates with especial reference to the use of centrifugal pumps, the causes of their unsuitability under certain conditions and remedial methods. G. R. N.

1323. Gasoline Blending with a Ratio Flow Controller. J. W. Brown and J. M. Jones. *Refiner*, 1937, **16** (6), 282.—Stabilized 4-lb. Reid vapour-pressure base gasoline is blended with natural gasoline expressure storage directly in the loading rack line by using a ratio flow controller. By using the correct orifice plates the controller can be set to blend any desired ratio of these gasolines. The laboratory determines the blend proportions, the specific gravity and the per cent. evaporated at 150° F. Over a day's loading, and excluding the first tank car, it was found that the maximum variation was for gravity 0·1° A.P.I. and for per cent. at 150° F. 0·5%. G. R. N.

1324. Progress in the Sulphuric Acid Refining of Cracked Distillates. F. Sagar. *Refiner*, 1937, **16** (6), 298.—A review of the work published since 1933 on the study of the time of reaction in sulphuric-acid refining of cracked distillates and critical discussion of the results. The process developments recorded in the literature since 1933 are reviewed and the Alfa Laval process is described. In the light of the results of the research work reviewed, the merit of the various novel features reported are discussed. G. R. N.

1325. Improving the Absorption Plant Cycle with Direct-Fired Heat. E. G. Ragatz and D. E. McFadden. *Refiner*, 1937, **16** (6), 305.—A comprehensive discussion with extensive data on the utilization of direct-fired heat for the operation of the absorption plant distillation equipment of the Union Oil Co. at Dominguez. It is concluded that (1) A continuous or semi-continuous oil-conditioning unit is absolutely essential to the satisfactory operation of a direct-fired heater in absorption plant service. (2) Given a proper quality of absorption oil, no spare unit need be provided for a properly designed heater equipped with adequate safeguards against feed-pump failure. (3) Stripping steam should continue to be used at the main stripping column. (4) The proper location for the fired heater is on a recirculated side stream drawn off the main column two or three trays below the feed plate. (5) The advantages of utilizing stripping steam in the main distillation column can be obtained without resorting to the continuous operation of an auxiliary boiler by the injection of a stream of water into a recirculated portion of the column bottoms. (6) A direct-fired heater installation becomes definitely attractive both from an initial investment standpoint and daily operating savings when the overall plant heat load exceeds 10,000,000 B.t.u. per hour. (7) The installation of a fixed-gas fractionator in a low-pressure plant appears definitely justified if the plant is recirculating 500,000 cu. ft./day or more of

fixed gases while operating on a normal butane loss ratio of 10% or over at the absorbers. G. R. N.

1326. Fractionation Practices. J. A. Campbell. *Refiner*, 1937, **16** (8), 380.—The author considers that the pumping of cold reflux to the evaporator of a natural gasoline plant is not the best procedure. His view is that the cold gasoline is flashed at the top plate, cooling it and passing to the condenser in vapour form. The cooling effect sets up internal reflux, which progresses down the evaporator, so the duty of this column is increased and it is necessary to supply extra heat by means of a reboiler or a heater located below the feed plate. A more effective and economical method of fractionation, according to his opinion, consists of using a partial condenser outside the evaporator, which should be water-cooled. The partial condensate is of much lower gravity, and it enters the top plate hot. This hot reflux washes back, for the most part, only the oil fractions and the heaviest gasoline fractions, and it does not flash in large quantities. With this system the evaporator is not chilled, and it is not necessary to provide a reboiler. The vapours will leave the top of the evaporator 80° to 100° warmer than the other system. A plant example is given.

G. R. N.

1327. Butane Used to Cool Absorption Oil at Carter's Fittstown Plant. D. H. Stormont. *Oil & Gas J.*, 5.8.37, **36** (12), 30.—A butane–propane mixture, consisting of about 85% butane and 15% propane, is taken from the bottom of the stabilizer when making butane-free gasoline at the natural gasoline plant of the Carter Oil Co. at Fittstown, Okla. This product is utilized to lower the temperature of the absorption oil leaving the water cooler by means of the usual compression and expansion method. The temperature of the oil is reduced from 87° to 60° F. by this method, with the result that the output of gasoline at the plant has been increased by 7000 to 9000 gals. per day. The peak capacity of the plant is 84 million in ft. per day, and a full description of the plant and illustrations of parts of it are provided.

When the plant is manufacturing 26–70 natural gasoline no butane is removed from the base of the fractionator. If a shortage of butane results from such continued operations, arrangements are made for the supply of butane from another plant. The amount of propane in the mixture is carefully controlled to avoid necessity for the use of higher compressions to liquefy the vapours. R. A. E.

1328. Development and Operating Characteristics of Atmospheric Cooling Towers. G. R. Nance and H. A. Dresser. *Nat. Petr. News*, 8.9.37, **29** (36), R.147.—The paper presents an outline of the development of atmospheric water-cooling devices, including still ponds, spray ponds and towers. Dealing particularly with towers, it is pointed out that for constant conditions efficiency varies with the exposed surface area of water, and efficient means of reducing the drop size of the water are essential. For this purpose the venturi-shaped, orifice-type distributor has been developed. Since cooling is by evaporation only, adequate draught must be provided, and tower sizes must be calculated on minimum wind velocities. The prevention of loss due to mist drift beyond the confines of the tower and basin necessitates the fitting of baffles the design of which shall not interfere with draught. The baffled-louvre has been developed for this purpose. For maximum efficiency per unit tower volume the approach of the final tower temperature to the wet-bulb temperature should be as large as possible. H. G.

1329. Electric Dehydrating and Desalting. J. J. Allison. *Refiner*, 1937, **16** (6), 267.—The Lion Oil Refining Co. desalt their very corrosive crude in an electrical unit from 100 gms. to 4 gms. per brl. Tests have shown that the evolution of hydrochloric acid at 650° F. was reduced from 63·85 lb. to 0·54 lb. per 1000 brls. of crude, thus reducing corrosion to a major extent. The salt-bearing crude is emulsified with 5–20% fresh-water, then passed to a low-pressure (25 lb.) dehydrator tank (180 brls. capacity) containing electrodes. An electric field of an average value of 10,000 volts per inch is imposed and salt-water is thrown out of the emulsion and removed. The process is continuous, the average throughput per day per unit being 1500 brls. Operating

temperatures may vary from 130° to 200° F. The installation of electric desalters has increased runs on the primary distillation units from 6 to 70 days. G. R. N.

1330. Improper Acidizing Presents Desalting Problems to Refining Industry. G. Egloff, E. F. Nelson, C. D. Maxutov and C. Wirth. *Oil & Gas J.*, 14.10.37, **36** (22), 57.—Treatment of wells in limestone formations with hydrochloric acid has resulted in the refinery being called upon to handle crudes containing sodium, magnesium and calcium chlorides and also free hydrochloric acid, resulting in serious corrosion or expensive chemical treatment, and affecting the quality of the fuel oil or asphalt. Corrosion is attributed to the HCl formed by hydrolysis of the salts, or to decomposition of chlorinated hydrocarbons formed during acidizing. The aggravation of sulphur corrosion in the presence of HCl has also been noted. (See Abstract No. 1342.) It is suggested that it may also catalyse the formation of H_2S from sulphur compounds. Analyses are given of the salt contents of a number of representative U.S. crude oils.

The commercial processes for the dehydration and desalting of crude include: (1) heat and pressure, (2) chemical, (3) electrical, (4) centrifugal and (5) filtration. A laboratory study has been made of the effect of temperature pressure, per cent. of water, emulsification, conditions of mixing of water and oil, depth and time of settling on a Mid-Continent topped crude.

It is found that the salt content was decreased by increasing the temperature or per cent. of water added. Optimum conditions were 10% water and 400° F. The pressure should be sufficient to keep the water at the temperature used in liquid form (about 300 lb. per sq. in. at 400° F.). Too violent agitation may stabilize the emulsion through the dispersion of the water in fine globules, so that only sufficient to bring about intimate contact between water and salt particles should be employed.

The amount of salt water withdrawn increases with the increase of settling time, whilst the concentration of salt in it reaches a maximum and then falls off. It is considered that the water globules carrying higher salt contents coalesced more rapidly than those of lower salt content. At low settling temperatures the percentage of water in the treated oil decreased more rapidly than the percentage of salt, owing to the unaffected films of asphaltic and paraffinous matter holding up the salt particles. At higher temperatures the reverse holds good owing to the absence of such films. There was little evidence of stratification in the settled oil, except for a tendency towards slightly higher salt concentrations in the upper layers. C. L. G.

1331. Design of Oil Absorbers. G. O. Kimmell and R. L. Huntington. *Refiner*, 1937, **16** (5), 220.—A semi-mathematical discussion of oil absorbers dealing with the equilibrium factor, the rate of absorption, absorber capacity and the quantity of gas absorbed in relation to the tower height. Graphs are given of the Kremser Absorption Factor and the percentage of total absorption with various absorber heights. Twelve references. G. R. N.

1332. X-ray Examination of Pressure Vessels Safeguards Refining Industry. W. L. Nelson. *Oil & Gas J.*, 15.7.37, **36** (9), 71.—A thorough superficial inspection of many faulty metal parts may fail to indicate a defect, but coupled with an X-ray examination it is possible to lower the chance of error so that long records of safety, soundness and dependability are possible. Some manufacturers of pressure equipment are already examining their products by this method, and the elimination of uncertainty opens up the possibility of developing new processes not previously contemplated on account of the high temperatures and pressures involved.

The thickness of metal that can be penetrated by X-rays is approximately :—

Rating of Tube.	Thickness in in.
200,000 volts peak . . .	3
400,000 volts peak . . .	5
Gamma rays (radium) . . .	10

X-ray pictures are usually in the negative form, and hence regions of lower density such as voids, cavities or cracks appear darker than the sound metal, and inclusions of heavy material appear light. Irregularities due to differences in thickness or shape

of the casting naturally cause differences in depth of shade. Mr. Van Horn of the Aluminium Research Laboratories catalogues defects:—(1) gas cavities, blow holes and minute gas porosity appear as well defined spherical or rounded darkened areas. (2) Shrinkage, pipe and shrinkage porosity are represented by filamentary or dendritic dark regions of irregular dimensions and indistinct outline. (3) Misruns appear as very prominent darkened areas of variable dimensions with definite smooth outlines where the metal has failed to fill. (4) Sand inclusions occur as grey to black spots of uneven or granular texture with indistinct extremities. (5) Cracks are represented by darkened lines of variable width, and are filamentary when derived from insufficient feeding or contraction (shrinkage) on cooling from the melt. Cracks originating from internal stress in solid metal are either angular or straight, and are of more constant width.

Radiographs of some of these faults are illustrated. The greatest use of X-rays in the petroleum industry is in the inspection of welds in pipe, pressure vessels and boilers. The order of frequency of defects is:—slag inclusion, porosity, cracks and incomplete fusion. Over 35 companies now use X-ray methods, and an increase in the use of welded pipes and fittings may be expected in refineries and for pipe-lines.

R. A. E.

1333. Corrosion-Resistant Lead Equipment. G. O. Hiers. *Refiner*, 1937, **16** (4), 168.—The composition, commercial forms and properties of lead are described, while its uses as a construction material and its resistance to corrosion are discussed. Twenty-nine references. G. R. N.

1334. Cast Iron in Chemical Equipment. H. L. Maxwell. *Refiner*, 1937, **16** (4), 163.—A review of the ways in which older types of cast iron have been used in chemical process equipment, and how, following failure in service, some of the compositions have been improved to provide materials of construction for equipment in which chemical products meeting all requirements as to quality have been produced at relatively low cost. G. R. N.

1335. Chrome–Nickel–Molybdenum Alloy for Tube Supports. C. L. Clark and R. S. Brown. *Refiner*, 1937, **16** (4), 178.—The use of large-size convection tube plates has brought into existence great temperature difference stresses, and these can be resisted by imparting permanent ductility to the alloy steel used. By combining a special melting technique with a substantial molybdenum content, a chrome-nickel steel known as Calite B-28 was produced, which showed no drop in ductility between 24 hours and 1000 hours at 1800° F. G. R. N.

1336. Carbon–Molybdenum Tubes for Polymerization Units. R. S. Brown. *Refiner*, 1937, **16** (4), 179.—For high-temperature cracking, as in thermal polymerization, conditions may go beyond the limits of strength and oxidation resistance of 4–6% chrome–0·50% molybdenum steel. Two calorized steels have been developed to meet the situation, one containing 2·25% chrome and 1·00% molybdenum, whilst the second contains 1·5% molybdenum. Tubes made from these alloys are calorized on both surfaces. G. R. N.

1337. Thermal Conductivity at Elevated Temperatures. W. G. Johnson. *Refiner*, 1937, **16** (4), 173.—The relative thermal conductivities of several plain and alloy steels were measured in the Honda–Simidu apparatus. From the results it was concluded that: (1) with an increase in carbon content of a plain carbon steel the thermal conductivity is decreased, the effect becoming less as the temperature is raised. (2) When plotting curves showing the relationship between thermal conductivity and chrome content (starting with 0·02% carbon steel) at each individual temperature, it is found that this property decreases with the increase in chrome content for all temperatures up to 800° C. At this temperature the thermal conductivity decreases until the chrome content is 13%. After this point on the curve it turns upward. The same holds true at 900° C. and 1000° C. (3) The addition of 7–9·5% nickel to 17–19% chrome has little effect at low temperatures, but at high

temperatures is very marked indeed, *e.g.* at 900° C. (4) The addition of 2–3% silicon to the austenitic chrome–nickel steels appears to lower their thermal conductivities, this suppressing effect being more marked at the highest temperatures. G. R. N.

1338. Applying Colloidal Chemistry to Water Conditioning. L. D. Betz. *Oil & Gas J.*, 30.9.32, **36** (20), 49.—Following a brief outline of the nature and properties of matter in the colloidal state, the particular value of colloids in water conditioning is discussed. Such colloids are of two classes: (*a*) *protective*, which do not enter into the precipitate as it is formed, but prevent small crystals from coalescing or adhering to surfaces when settling and (*b*) *reactive*, which possess a direct reaction and remove from solution scale forming solids. Starch and tannin are examples of the former class, both being hydrophobic colloids, positively charged and do not react with polyvalent positive ions, *e.g.* Ca and Mg. Colloids of the laminaric acid series are valuable members of the latter class, and are hydrophilic, carrying a negative charge. Each particle is capable of taking up several Ca or Mg ions, resulting in the conversion of the colloid from a sol to a gel. The Ca or Mg is thus removed in an organic form in a type of precipitate which cannot adhere or crystallize, and by virtue of its enormous surface possesses the ability to remove suspended solids by adsorption to a very large degree.

A study of the reactions of colloids should be of the greatest value in the reconditioning of water for boiler and cooling purposes. C. L. G.

1339. Carbon Dioxide for Fire Protection. J. F. Kidde. *Refiner*, 1937, **16** (7), 345.—All CO_2 types of extinguisher use it in liquid form under its own pressure in steel cylinders. Upon release through a nozzle the liquid forms a snow and a heavy gas. The extinguishing equipment may be in the form of mobile or portable units and fixed systems. The portable size may vary from 2 to 100 lb. in capacity, and the discharge is applied directly to the fire. In the fixed systems the alternatives are total flooding and local application. The latter is similar to the portable in that the discharge must strike the fire; the nozzles, however, are in a fixed position. The advantages of this type of fire protection if installed in the various refinery departments are shortly discussed. G. R. N.

1340. Patents on Plant. G. L. Mateer and G. F. Eustis. U.S.P. 2,090,691, 24.8.37. Stabilizer control for depropanizing cracked distillates.

C. Lowery. U.S.P. 2,091,151, 24.8.37. Means of separating oil from water or gas or sand.

G. B. Coubrough. U.S.P. 2,092,528, 7.9.37. Apparatus and method for distilling petroleum mixtures. W. S. E. C.

Corrosion.

1341. Corrosion of Metals in Soils as a Factor in Selecting Materials for Pipe-Lines. S. Ewing. *Oil & Gas J.*, 30.9.37, **36** (20), 51.—The results of corrosion tests on various metals carried out by the Bureau of Standards in 23 different types of soil are compared with the chemical composition of the metals.

No relation between the amounts of carbon, manganese, sulphur, silicon or copper and the pitting rates of ferrous metals was found. With phosphorus, however, the resistance to pitting increased with the percentage of phosphorus (up to 0·10%). This has already been experienced with air-exposure tests, but is not noticed with water-exposure tests. The relatively high percentage of phosphorus in old puddled wrought iron may account for the exceptional performance of such pipes. Chromium and nickel steels showed little advantage over ordinary steels, whilst Duriron (a cast iron containing 14·5% silicon) was in general highly resistant to corrosion. Copper is liable to corrode in soils containing chlorides and carbonates owing to the setting up of differential aeration cells, and in contact with *e.g.* cinders containing unburnt carbon and in the presence of H_2S.

In tidal marshes corrosion of copper is uniform and about half the rate of ferrous metals, lead and muntz metals being the only promising corrosion-resistant metals

in this soil. In soils composed mostly of organic matter, the organic acids tend to dissolve the protective oxide films formed on copper, but less rapidly than in the case of ferrous materials. In general, corrosion rates of copper and copper alloys were not related to soil resistivities, but rather to the p_H values and ratio of chlorides and carbonates to sulphates. Muntz metal (60–40 CuZn), although very liable to dezincification in corrosive soils, showed greater resistance in tidal marshes than copper or high copper brasses.

Cathodic protection of copper pipe at the expense of steel pipe is frequently of value in underground copper installations.

Lead pipes are resistant in soils containing sulphates or carbonates owing to the formation of protective coatings, whereas oxygen, nitrates, chlorides, alkalies and organic acids tend to dissolve the protective film or to set up potential differences on the metal surface.

Heavy zinc coatings gave considerable protection to steel pipe, but lead little protection owing to the presence of minute pinholes giving galvanic couples in which the iron corrodes and the lead is protected. C. L. G.

1342. Practical Methods Used to Prevent Corrosion from Mid-Continent Oil. R. E. Puckett. *Oil & Gas J.*, 23.9.37, **36** (19), 44.—Sudden increases in the corrosion of refinery equipment handling Mid-Continent oil developed after acidization of the wells in the field. Within 60 days two pipe stills and four Dubbs units at a Wichita refinery, which had been running for 8 years at a normal rate of deterioration, showed severe corrosion of bubble towers and cracking plant tubes.

The crude has a salt content of 55 lb. NaCl, 6 lb. $MgCl_2$ and 26 lb. $CaCl_2$ per 1000 brls., whilst the water separated from the sour gasoline showed saturation with iron chloride. Injection of ammonia into the fractionating tower at the kerosine pan showed no improvement, but injection into the cold crude-oil-charging pump showed an immediate improvement, contrary to the advice of ammonia manufacturers, who state that the gas is decomposed at about 800° F. It was concluded that the amino-compounds formed rendered the crude alkaline. Using 8 lb. ammonia per 1000 brl. crude, tube replacement in the Dubbs furnaces dropped by 75%.

The sudden increase in corrosion was attributed to the presence of free hydrochloric acid, which was found present in the Kansas crude to the extent of up to 7 lb. per 1000 brl. Contrary to general belief that HCl corrosion is of importance only in low-temperature sections, it is considered responsible for corrosion in the stills at temperatures up to 780° F. It is pointed out that the dissociation of HCl is reduced by only 30% between 65° F. and 200° F. There is also a possibility of acid and acid salts setting up an oxidation reduction cell between the still wall and sulphur compounds, which pass over the surface. The effect of ammonia is to neutralize the HCl and prevent it from dissolving the protective film of iron sulphide. It is considered that the p_H value of the condenser draw-off water should be held at 9 (rather than 6·7), since the excess of ammonia should counteract, by the law of mass action, the low heat of formation of the sulphide formed from corrosive sulphur compounds.

The salt is removed from the crude oil on the field by scrubbing with 20% of water followed by electrical dehydration. Ammonia injection into the crude, however, failed to control the corrosion of tubes in the heavy oil furnace and convection bank of a new Dubbs unit operating at higher pressures than those previously used. This was attributed to turbulence removing the normal sulphide films formed. No undue corrosion was experienced in the light oil furnace with a velocity of 7·5 ft. per sec. (as compared with 16·7 ft. per sec. for the heavy oil furnace). The real cause of the excessive corrosion ($\frac{5}{16}$-in. tubes reduced to sheet tin thickness in 16 days) has never been satisfactorily explained, but may be an accelerated sulphur corrosion due to traces of acid salt, or possibly a cyclic sulphur corrosion due to unknown factors. Corrosion control was effected by a lime slurry of 0·32 lb. anhydrous lime per brl. It is pointed out that as the reactivity of lime depends on the active surface available, the particle size should be controlled—as by settling tests. Sufficient lime is added to keep the H_2S content of the still gases below 0·2 lb. per 1000 cu. ft.

Satisfactory protection of the Dubbs unit with lime has now been effected. Details of the method of determining salt, calcium and magnesium in the crude and H_2S in the still gases are given. C. L. G.

1343. Corrosion in Water-Tube Boilers. D. Brownlie. *Fuel Economist*, 1937, **12** (143), 384.—With the rapid increase in the evaporative capacity of water-tube boilers the problem of corrosion has assumed growing significance. The article briefly surveys the position, and outlines the more favoured methods of combating this problem, such as softening and de-aerating. The use of graphite paint is given special attention, and a particular brand is given strong recommendation.

T. C. G. T.

1344. Ammonia for Corrosion Control. L. H. Brandt. *Refiner*, 1937, **16** (8), 382.—To-day in the petroleum industry the most serious source of acidic corrosion is moist magnesium chloride, which is hydrolysed during distillation liberating hydrogen chloride. Ammonia is the only suitable volatile alkali to effect its neutralization and removal. It can be supplied in anhydrous form in 100–150 lb. steel cylinders, or in tank cars of 10,000 galls. capacity, while as an aqueous liquor it is packed in 55 and 110 gall. drums or in low-pressure tank cars. Ammonia must be handled by all iron or steel equipment. In crude oil distillation the ammonia is injected after the crude-oil pump and before the first heat exchanger. It is not recommended for high-temperature equipment (900° F. and above), since it dissociates. Control of the neutrality of the subsequent condensate is by p_H value, the preferred indicator being bromthymol blue. The paper also includes data on the properties of anhydrous and aqueous ammonia, its physiological action, costs, and layout of ammonia storage.

G. R. N.

Chemistry and Physics of Petroleum.

1345. Dealkylation of Dialkyl Benzenes. V. N. Ipatieff and B. B. Corson. *J.A.C.S.*, 1937, **59**, 1417–1418.—This paper presents the results of a study of the action of a number of catalysts on the reaction of dealkylation.

It was found that di-*tert.*-alkyl benzenes are dealkylated in the presence of ferric chloride and benzene to give high yields of the corresponding mono-derivatives. Hydrogen chloride is liberated during the reaction and the ferric chloride is reduced to the ferrous state. Di-*sec.*- and di-*prim.*-alkylbenzenes are not dealkylated under the same conditions.

Sulphuric, phosphoric and perchloric acids were also tested as dealkylating catalysts. 1 : 4-di-*tert.*-butylbenzene reacts with benzene in the presence of sulphuric acid to give mono-*tert.*-butylbenzene and *p*-*tert.*-butylbenzene-sulphonic acid. The *para*-position of the sulphonic acid group indicates that dealkylation precedes sulphonation.

The dealkylation of di-*tert.*-butylbenzene was also catalysed by phosphoric acid, but not by perchloric acid.

W. E. J. B.

1346. Addition of Thiocyanic Acid to Olefinic Double Bonds. M. S. Kharasch, E. M. May and F. R. Mayo. *J.A.C.S.*, 1937, **59**, 1580.—The authors have succeeded in adding thiocyanic acid to a number of olefins, *e.g.* an ether solution of thiocyanic acid with an equimolar amount of *iso*butylene yielded after 4 hours at room temperature, a mixture of *tert.*-butylthiocyanate and *tert.*-butyl*iso*thiocyanate, in the approximate proportions of 1 to 2. Similarly, trimethylethylene, styrene, 2-pentene and camphene add thiocyanic acid.

W. E. J. B.

1347. New Reaction for Unsaturated Hydrocarbons and Peroxides. E. Lederer. *Petr. Z.*, 22.9.37, **33** (38), 9–13.—Mn and also Co salts of organic carboxy and sulpho-acids give with most unsaturated compounds characteristic colour reactions which are connected with the formation of peroxides. Tendency to polymerize inhibits the reaction. Ag salts, on the other hand, give colours according to the state of division of the reduced Ag. The Mn reaction is quantitative colorimetrically for peroxides.

J. W. J.

1348. Influence of Metallic Oxides on Neoprene Properties. H. W. Starkweather and M. W. Walker. *Ind. Eng. Chem.*, 1937, **29** (8), 872.—Data are given showing the effect of various metallic oxides on the stability of uncured neoprene and on the physical properties of cured neoprene. The most useful oxides are those of zinc and

magnesia, and calcium cannot be advantageously substituted for magnesium. The addition of litharge together with magnesium or zinc oxide results in products having low moduli and tensile strengths, but possessing superior water resistance.

H. C. R.

1349. Viscosity Temperature Function. E. L. Lederer. *Petr. Zeit.*, 8.9.37, **33** (36), *Motorenbetrieb.*, **10**, 2–7.—The second differentials (η'') of the viscosity–temperature curves for various substances have been examined. It is shown that, within experimental error, $\log \eta'' = a/T - b$, the constants a and b having the dimensions, respectively, of energy and entropy. This quantity provides a theoretical basis for the criteria of an oil such as V.I. and V.G.C.

J. W. J.

1350. Heat-Transfer Coefficients for Condensing Dowtherm Films. W. L. Badger. *Ind. Eng. Chem.*, 1937, **29** (8), 910.—The coefficients for condensing Dowtherm A were determined in experiments by Ullock and Badger (*Ind. Eng. Chem.*, 1937, **29** (8), 905), and it is shown that they can be well correlated by the method suggested by Kirkbride (*Trans. Amer. Inst. Chem. Eng.*, 1933, **30**, 170), in which $h\left(\frac{\mu^2}{k^3\rho^2 g}\right)^{\frac{1}{3}}$ is plotted against $\frac{W}{\mu D}$.

P. D.

1351. Heat-Transfer Coefficients in the Boiling Section of a Long-Tube Natural Circulation Evaporator. C. H. Brooks and W. L. Badger. *Ind. Eng. Chem.*, 1937, **29** (8), 918.—Overall heat-transfer coefficients were determined for the boiling section of a natural-circulation evaporator. The method of determining the point at which evaporation starts was to determine the point of maximum temperature in the tube (see also *Ind. Eng. Chem.*, 1937, **29** (8), 912). The results are correlated by plotting $\Delta t_{av.}$ against $\frac{U_B V^{0.27}}{W_f^m}$, and $\Delta t_{av.}$ against m.

$\Delta t_{av.}$ = average mean temperature difference in boiling section.
U_B = average overall heat-transfer rate in boiling section.
V = vapour produced.
W_f = feed rate.

The action of the fluid in the tube is discussed.

P. D.

1352. Liquid-Film Heat-Transfer Coefficients for Condensing Dowtherm A Vapours to Petroleum and Linseed Oils in a Vertical Tube Heater. D. S. Ullock and W. L. Badger. *Ind. Eng. Chem.*, 1937, **29** (8), 905.—Heating experiments were carried out in two vertical nickel tubes $\frac{3}{4}$ inch in dia., 10 ft. long. Special surface couples were fitted. The results agreed well with the Dittus and Boelter equation:

$$\frac{hD}{k} = 0{\cdot}0225\left(\frac{Du\rho}{\mu}\right)^{0.8}\left(\frac{C\mu}{k}\right)^{0.4}$$

h = film coefficient.
D = tube diameter.
k = thermal conductivity.
u = oil velocity.
ρ = oil density.
μ = oil viscosity.
C = specific heat.

The temperature range used was 350° to 600° F. for the petroleum oil (140 secs. Saybolt at 210° F.) and 570° to 600° F. for the linseed oil. The range of Reynolds Number (Re) was up to 50,000 for the former, and 90,000 for the latter oil. The authors point out the difficulty in interpreting results which lies in the lack of accurate knowledge of the thermal conductivity. For this the following equations were used:

For petroleum oil :—$k = 0{\cdot}864\ (S)(C\rho)^3\sqrt{S/M}$
For linseed oil :—$k = 0{\cdot}342\ (S)(C)^3\sqrt{S/M}$
S = specific gravity referred to water at 4° C.
M = molecular weight.

During the process of heating the linseed oil "bodies" increased in molecular weight and viscosity. This was carefully allowed for.

In interpreting the linseed oil results, $\frac{hD}{k} \div \left(\frac{C\mu}{k}\right)^m$ was plotted against $\frac{Du\rho}{\mu}$, using log. scales, for values of $m = 0{\cdot}30$, $0{\cdot}40$, $0{\cdot}50$, and by this means it was found that the best correlation for this oil was given by the equation:

$$\frac{hD}{k} = 0{\cdot}00725 \left(\frac{Du\rho}{\mu}\right)^{0{\cdot}67} \left(\frac{C\mu}{k}\right)^{0{\cdot}5}.$$

P. D.

1353. Temperature Drops and Liquid-Film Heat-Transfer Coefficients in Vertical Tubes. R. M. Boarts, W. L. Badger and S. J. Meisenburg. *Ind. Eng. Chem.*, 1937, **29** (8), 912.—Experiments were made in which tube temperatures and fluid temperatures were determined in a long vertical-tube forced-circulation evaporator. The temperatures are plotted against tube length, and it is found that the fluid temperature rises to a maximum and then falls to the temperature of the separator. The point of maximum temperature is that at which evaporation starts, and this lies nearer the entrance of the tube for low rates and consequent larger amounts of evaporation.

For those runs in which evaporation was small, it was shown that the heat transfer coefficients can be calculated by the equation of Dittus and Boelter. When higher percentages of evaporation are used, this equation gives values which are low.

The heating may, however, be considered as taking place in two parts: first in the non-boiling section, up to the point of maximum fluid temperature, for which section the Dittus and Boelter equation can be applied, and secondly in a boiling section.

The results are correlated by means of an empirical equation for determining the average liquid temperature from the entrance temperature and the rate of flow.

P. D.

1354. Simple Gas Thermoregulator. R. M. Kingsbury. *Ind. Eng. Chem. Anal.*, 1937, **9** (7), 333.—In the conventional mercury–toluene type of regulator the flow of gas is controlled by a glass valve which opens or closes the inlet as the height of the mercury column alters with the temperature. This obviates the common fault of this regulator, *i.e.* the rise in temperature due to the current of incoming gas causing small globules of mercury to rise and adhere to the sides of the tube. G. R. N.

1355. Mol Method in Computations. E. F. Dawson. *Refiner*, 1937, **16** (7), 341.—The writer considers that the use of the mol in calculations answers the engineer's need for a simple direct and short means for evaluating many problems, particularly chemical in nature. Fully worked out examples of its use are given for density, specific volume and gas gravity, volume–weight analyses, carbon–hydrogen balance for flue gas–fuel comparison, flue gas–fuel ratio, flue gas–air ratio, and air–fuel ratio.

G. R. N.

Analysis and Testing.

1356. Graphic Analysis of Hydrocarbon Oils. C. H. Fisher and A. Eisner. *Ind. Eng. Chem. Anal.*, 1937, **9** (8), 366.—A graphic method of characterizing hydrocarbon oils is developed, depending on changes in volume and physical constants caused by the progressive removal of unsaturates and aromatics. The density and refractive index rise to maximum values at the point of complete olefin and incipient aromatic removal. Beyond this point the values fall as the aromatics are removed, becoming approximately constant when the residual oil consists only of saturated hydrocarbons. The unsaturate content is indicated by the volume change from maximum physical constants to the point of complete extraction of aromatics (constants little changed by further treatment with acid). The unsaturate and aromatic contents of three oils were determined accurately by this method. Whether or not the points of maximum and minimum physical constants always indicate the olefin and aromatic contents precisely, this method affords a good characterization of neutral oils, and should be

useful for comparative purposes. The data obtained during the progressive removal of olefins and aromatics may be used to calculate the physical constants of some of the extracted constituents. In the present work such calculations demonstrated that the aromatics from a high-boiling hydrogenated coal distillate had higher physical constants than the aromatics from two petroleum gasoline fractions. G. R. N.

1357. Determination of Arsenic in Mineral Oil Solutions. J. B. Lewis and E. L. Baldschwieler. *Ind. Eng. Chem. Anal.*, 1937, **9** (9), 405.—A 3–5 gm. sample of the solution and 10 gms. anhydrous potassium sulphate are placed in a Kjeldahl flask fitted with a dropping funnel and connected to a special condensing train. About 20 ml. concentrated sulphuric acid are added from the funnel. When charring has occurred 20 ml. concentrated nitric acid are added and some heat is applied by a low flame. When the reaction subsides, more nitric acid is added and the heating is continued to gentle boiling, this process being repeated until the solution is clear and of a straw-yellow colour. This should take about 2 hours. The washings from the condensing train and receiver flask are concentrated in a beaker on the steam bath, then added to the solution in the Kjeldahl flask, which is heated until SO_3 is evolved. A little nitric acid is added and the solution is heated until it fumes, it is then cooled in ice and diluted with water. The solution is now ready for the determination of arsenic by any standard method, the one favoured in the present instance being precipitation and ignition to $Mg_2As_2O_7$. Results are given. G. R. N.

1358. Determination of Small Quantities of Oxygen in Gases and Liquids. I. J. W. MacHattie and J. E. Maconachie. *Ind. Eng. Chem. Anal.*, 1937, **9** (8), 364.—Oxygen in gaseous mixtures and dissolved in liquids can be accurately determined in small quantity by absorption on copper wetted with an ammoniacal solution of ammonium chloride, the resulting oxide being dissolved in the same solution and the copper derived being estimated by titration of a blank to the same depth of blue colour. The arrangement of apparatus described is capable of measuring oxygen with an accuracy of 3% in amounts from 0·02 to 2 ml. No interference is caused by gases usually encountered, and determinations are made at a rate of four in an hour. G. R. N.

1359. Determination of Carbon and Hydrogen. H. Levin and K. Uhrig. *Ind. Eng. Chem. Anal.*, 1937, **9** (7), 326.—An apparatus and method are described for the determination of the carbon and hydrogen content of gasoline or other volatile liquids by combustion. A feature of the apparatus is a device by means of which the rate of volatilization can be controlled and combustions conducted to completion in an atmosphere of oxygen without explosion. G. R. N.

1360. Small Chemical Changes in an Insulating Oil. R. N. Evans and J. E. Davenport. *Ind. Eng. Chem. Anal.*, 1937, **9** (7), 321.—The initial chemical changes associated with the oxidation of an insulating oil can be revealed only by special analytical technique. Methods are given for the determination of strong acid, soluble copper or lead and saponifiable matter. A type of oil oxidation inhibition is illustrated in which the strong acid is the only measurable product of the reaction. It was concluded—*inter alia*—that oxygen must be present to bring about strong acid formation, and copper was instrumental in increasing this effect. G. R. N.

1361. Direct Determination of Low Vapour Pressures. K. C. D. Hickman, J. C. Hecker, and N. D. Embree. *Ind. Eng. Chem. Anal.*, 1937, **9** (6), 264.—After describing the development of their various tensimeter-hypsometers, the authors give details of two methods for determining the vapour pressures of substances over the range 0·001 to 4·0 mm. The vapour pressures from 1 to 50 microns of mercury are given for two vacuum pump fluids, two sterols and a dye. G. R. N.

1362. Physical Method for Drying Liquefied Hydrocarbons. E. E. Roper. *Ind. Eng. Chem. Anal.*, 1937, **9** (9), 414.—A method of filtering is described which is applicable to liquids at low temperatures (− 80° to − 130° C.). The essential features are the manner of constructing the filter tube, the filtration being conducted under the vapour

pressure of the substance and the utilization of the vapour pressure to force the liquid through the filter tube. This method was applied to seven hydrocarbons, propadiene, 2-methylpropene, 1-butene, etc., and it was demonstrated that the product from the filtration contained a negligibly small amount of water. The filter medium was glass wool. G. R. N.

1363. Reaction of Alcohol–Gasoline Blends to the Doctor Test. W. K. McPherson and L. M. Christensen. *Ind. Eng. Chem. Anal.*, 1937, **9** (9), 433.—The commercial distribution of alcohol–gasoline blends led to reports that these fuels give a sour reaction to the doctor test. A series of tests was made on various substances, which are commonly used as denaturants for ethyl alcohol, and ethyl alcohol itself. Except for gasoline and benzene, the result was a sour reaction. The same result was obtained with an alcohol–gasoline blend containing 40% alcohol. G. R. N.

1364. Relationship Between Laboratory Column Distillations and A.S.T.M. End-Points. V. W. Garton, W. C. Moyer and H. T. Quigg. *Refiner*, 1937, **16** (8), 367.—A 5-ft. Peters–Leslie column and a 6-ft. unlagged steel column were used to carry out fractional distillations on East Texas and Tonkawa, Oklahoma, crude oils. The A.S.T.M. end-points of appropriate fractions were compared graphically with the corresponding cutting temperatures in the column. The data agreed closely with that obtained by A. J. Good and others, showing that the true boiling point cut temperature and the A.S.T.M. end-point are about equal around 400° F. Below that temperature the A.S.T.M. end-point runs consistently higher than the cut temperature, whilst above 400° F. the reverse is true. G. R. N.

1365. Constant-Temperature Bath for the Asphalt Laboratory. H. Bottomley. *Refiner*, 1937, **16** (5), 227.—The bath consists of a double-walled copper tub, rock wool or other insulating material being packed in the annular space. The water is circulated by means of a centrifugal pump, being drawn from the bottom and discharged about the centre of the side. A medium sensitivity thermoregulator is used to turn the 500-watt knife-type heater and the circulating pump motor on and off as needed. A resonant circuit-type relay is used as the switch. The asphalt samples are placed on a shelf about 1½ inches from the bottom. G. R. N.

1366. Improved Ductility Machine. R. R. Thurston and C. E. Cummings. *Ind. Eng. Chem. Anal.*, 1937, **9** (6), 286.—The ductility machine used by the Texas Co. is described. Improvements consist of: (*a*) a monel-metal tank inserted in a steel tank, both containing water, which in the latter case is agitated while its temperature is thermostatically controlled. (*b*) The carriage for the moulds is mounted on rails fixed to the tank top and moves on grooved wheels (ball bearings). (*c*) Movement of the carriage is by means of a flexible stainless steel cable winding on a grooved drum. (*d*) The driving mechanism provides for four speeds—0·25, 1, 5 and 10 cm. per minute. G. R. N.

Motor Fuels.

1367. Effect of Sweetening on the Properties of Gasoline. W. A. Schulze and A. E. Buell. *Refiner*, 1937, **16** (6), 268.—Experimental data are presented to show that gasoline solutions of mercaptans and the corresponding disulphides have the same octane number within the range of concentrations encountered in commercial gasolines. These compounds act similarly in gasolines containing tetraethyl lead equivalent to 1 ml. per gall. Losses from 0·5 to 3 octane numbers are shown on gasolines sweetened in plants employing various modifications of the doctor-sweetening process, the losses being explained on the basis of the higher alkyl polysulphides formed during the oxidation of the mercaptans in the gasolines. Experimental data confirm the statement that the deleterious alkyl polysulphides are not formed in sweetening by the copper process. Direct comparison of sour and copper-sweetened gasolines shows that for all practical purposes the octane number is unchanged during the sweetening treatment. The higher alkyl polysulphides formed in doctor sweetening are unstable compounds and make gasoline exhibit reversion, and become potentially corrosive. Synthetic and natural gum inhibitors are likewise rendered less effective. G. R. N.

1368. Vapour-Lock Research Involves Study of Motor Fuel Quality. G. G. Oberfell. *Oil & Gas J.*, 29.7.37, **36** (11), 94.—The history of the problem is reviewed and a bibliography of the literature on the subject prepared. The quality history of motor fuel in respect of 10%, 50% and 90% evaporated temperatures and Reid vapour pressure at 100° F. is presented in graphical form for the years 1915–36, some of the figures naturally being deduced. The effect of cracking processes since 1920 has been to increase average vapour pressures by 4 lb., to decrease the 10% evaporated temperature by 50° F. and to decrease the 50% and 90% evaporated temperatures by 30° F.

Whereas during the period 1915–19 automotive designers were faced with the problem of supplying additional heat to the fuel system, the subsequent changes in fuel volatility have necessitated changes in design to secure lower fuel system temperatures. Present vapour-lock difficulties can be laid to the failure of fuel-system design to keep pace with the changes in fuel characteristics.

Tables show: (1) the estimated composition of motor fuel in terms of refinery base gasoline of zero volatility number, vapour-recovery plant gasoline, natural gasoline (butane-free) and butane (irrespective of source) for the years 1925–37. (2) Estimates of butane available, extracted and included in motor fuel. The data show (1) that only about one-fifth of the volatility of present-day motor fuels is derived from the use of natural gasoline, (2) more extensive and more drastic cracking and more efficient extraction of light gasoline from refinery vapours are the major factors responsible for the changes in motor fuel quality. (3) Increasing quantities of butane are available at refineries, more is being extracted, but even now only about half the butane available from all sources is finding its way into motor fuel.

The Reid vapour-pressure test has been available since 1930 with subsequent modifications. An improved method to cover testing of both motor fuel and natural gasoline will shortly be made available by the A.S.T.M. Owing to the choice of a low vapour–liquid ratio for test conditions and the choice of a low numerical limit in specifications, the test is considered to be entirely adequate to safeguard against the danger of vapour lock.

A history of vapour-lock research since 1928 is given. Medium-priced cars usually have reasonably satisfactory fuel systems, but the worst cars, which stand in the way of higher vapour-pressure fuels, are usually the more expensive. A good system should be no more costly than a poor one. If all systems were as good as the best studied by Bridgeman, there would be no wasted butane at refineries.

The Automotive Survey Committee of the A.P.I. commenced a comprehensive survey of the problem in 1935, and its results will obviously be of great importance to the refining industry. There is need for further information on (1) repeatability of vapour-lock road tests, (2) temperature correction factor for varying atmospheric temperature, (3) magnitude of losses through evaporation from the carburettor bowl. In recent years higher under-bonnet temperatures and changes in design have offset any improvements effected by reduced fuel-system temperatures and greater vapour-handling capacities of the systems. R. A. E.

1369. Patents on Motor Spirit. Houdry Process Corpn. E.P. 470,588, 18.8.37. Reforming naphtha by passing it in the vapour form at 850° F. and over 15 lb. pressure over a contact mass consisting of a blend of alumina and silica.

R. W. Henry, J. A. Reid and W. A. Schulze. U.S.P. 2,089,373, 10.8.37. Sweetening of gasoline by means of a solution of cupric chloride, sodium chloride, and copper sulphate.

A. J. Paris, Jr. U.S.P. 2,089,760, 10.8.37. Treatment of motor spirit or lubricating oil containing unsaturated hydrocarbons with a nitrogen containing gas free of water vapour and then compressing the mixture.

K. G. Mackenzie. U.S.P. 2,090,007, 17.8.37. Motor spirit produced from cracked vapours separated by fractional condensation of cracked naphtha distillate. The latter is distilled into a lighter fraction, which is mildly refined with fullers' earth, and this fraction is blended with cracked naphtha distillate, from which the lighter fractions have been removed and undergone acid refining.

C. E. Dolbear. U.S.P. 2,090,190, 17.8.37. Refining of "doctor sour" gasoline by means of air and sodium ferrite.

F. W. Hall. U.S.P. 2,091,239, 24.8.37. Refining of naphtha distillates by passing them dissolved in copper naphthenate through a heating coil at 800–1200° F. under superatmospheric pressure.

M. H. Arveson. U.S.P. 2,092,199, 7.9.37. Solvent fractionation of cracked petroleum naphtha by contacting with cresylic acid and ammonia.

A. E. Buell. U.S.P. 2,094,485, 28.9.37. Sweetening of gasolines containing mercaptans by adding air to the gasoline and contacting with fullers' earth impregnated with an aqueous solution of a soluble copper salt and sodium chloride.

W. S. E. C.

Lubricants and Lubrication.

1370. Lubrication and Cooling Problems of Aircraft Engines. W. Worth. *J.S.A.E.*, 1937, **41**, 315–324.—The first part of this paper deals with the lubrication problem in three sections, viz. the supply of oil in proper condition under stabilized conditions. The obtaining of a lubricant condition in cold weather permitting of easy starting, and the supply of correct lubrication immediately after starting up and elimination of oil warming-up period.

The latest Material Division lubrication system designed to overcome these problems is fully described and illustrated. A jacketed oil cooler with automatically controlled viscosity control valve ensures that the by-passed oil maintains a warmed passage through the core, preventing congealing. It is stated that the most satisfactory solution to the lubrication at starting problem is the oil dilution system, and the method used to dilute a portion of the oil prior to stopping, using a hopper tank, has proved very satisfactory. Tests were made with this system in which the oil was alternatively diluted and run on full load for 1 hr. over a period of 70 hrs., after which the oil condition was substantially the same as after a 5-hrs. run-in period prior to first dilution.

The second part of the paper deals with cooling systems for liquid-cooled engines. The standard general arrangement adopted by the Air Corps is described. The bad effects of badly designed radiator systems are dealt with, and the author presents a method of tackling the problem of radiator design, and gives curves showing the effect on drag horsepower of several variables. To illustrate this design method, a complete set of calculations is given for an assumed problem, viz. the design of a radiator for a fully supercharged 1000-h.p. engine with a heat rejection of 350 h.p. and a coolant flow of 200 galls. per minute in an aeroplane with maximum climb speed of 130 m.p.h. and a maximum speed of 300 m.p.h.

C. H. S.

1371. Low Lubricating Stock Loss is Feature of New Lion Oil Vacuum Filter. J. J. Allison and J. B. Rogerson. *Oil & Gas J.*, 15.7.37, **36** (9), 73.—In general, the improvements made on the Sweetland press since the beginning of contact filtration have been labour-saving devices of minor importance. The development of the Oliver pre-coat vacuum filter offers an entirely new and better method of clarification. The filter installation at the Lion Oil Refining Co. plant in El Dorado, Ark., operates continuously for a period of 7 days, requiring no attention over this entire period other than for disposal of spent clay. Throughout the cycle the filtrate is entirely free of solids, and no after-filtration clarification is required.

The pre-coat filter resembles the standard Oliver continuous filter in general appearance. The operating cycle consists of two phases—pre-coat formation and clarification. High flow-rate, diatomaceous earths are used for pre-coat formation, and are mixed into a slurry with a non-viscous petroleum fraction. The slurry is fed into the filter tank in which a monel metal cloth-covered cylindrical drum revolves. Vacuum applied to the drum builds the pre-coat (2 in. thickness) upon the filter surface in about 1 hr. Oil to be clarified is then fed to the filter tank, where a liquid level is maintained. Constant vacuum on the rotating drum filters the oil through the pre-coat, leaving a layer of filter clay on the surface. As the drum surface leaves the oil level, drying of cake commences, and continues to the point of discharge, where an advancing knife edge shaves off the clay layer, together with a thin film

of the filter aid, so that a fresh surface of pre-coat is presented for further clarification with each revolution of the filter drum. Spent clay is removed by means of a scroll conveyor. Throughput rate of the filter can be controlled by: (1) varying speed of rotation of the drum, (2) varying the liquid level—that is, the degree of submergence of the drum in the oil—(3) varying filtration temperature, (4) varying the amount of vacuum applied to the drum.

A description is given of the actual installation at the El Dorado plant. Main details are: Oil viscosity 68 secs. at 210° F.; no dilution of stock; no oil-recovery process used for cake owing to low loss experienced; drum speed 2·5 mins. per rev. at 36% drum submergence; charging stock temperature 300 to 500° F.; operating vacuum 21 in. mercury; filter rate capacity 16 gals. per sq. ft. per hr.; knife advance into pre-coat 0·0004 in. per revolution of drum; pre-coat thickness reduced from 2 in. to ½ in. in 7 days; oil loss in filter cake 27·23 by wt.; net oil loss 0·47% of stock charged.

At 55% permissible drum submergence a full capacity of 22 gals. per sq. ft. per hr. is indicated. Results of trials at lower vacuum and drum speed are recorded.

Laboratory tests indicate that bright stocks can be filtered without dilution, but if naphtha dilution is desired, lower vacuum may be employed and the cake washed by naphtha spray before reaching the discharge zone. Vacuum pump gases can be exhausted through a condenser or absorber to minimize solvent loss. Alternatively, oil may be recovered without dilution of stock by dropping spent clay into a tank of solvent used in the dewaxing process and charging to a second filter.

It is estimated that such an installation would reduce by 50% the labour costs of the average bright stock contact plant, practically eliminate solvent losses and yield a filtrate entirely free from suspended solids. R. A. E.

1372. Deasphalting and Acid-Treating of Lubricants with Propane. W. H. Bahlke, E. W. Thiele, C. E. Adams and B. Ginsberg. *Oil & Gas J.*, 22.7.37, **36** (10), 44.—Preliminary tests and calculations showed that of the various possible improved processes for manufacture of lubricating oils from Mid-Continent residuum, the most promising consisted of deasphalting and acid-treating a short residuum in propane solution (Bray, U.S. Pat. 1,949,989), subsequent cold settling and percolation being conducted as before. The results of laboratory work on deasphalting are recorded and the apparatus used is described. Factors investigated included: (1) ratio of propane to oil, (2) deasphalting temperature, (3) quality of propane used, *i.e.* natural gasoline or refinery grade, (4) effect of acid strength and temperature. Results of experimental runs are tabulated. The choice of operations for commercial plants was based on the laboratory work, and special features are described. A simplified flow sheet of the commercial plant, charging 55,000 gals. of residuum per day, at Whiting, Ind., is provided.

Propane and residuum are pumped through two orifice mixers (a portion of the propane entering each mixer) to the asphalt settler, from which asphalt is removed continuously by means of a liquid level controller. The asphalt passes to a flash tower, and thence to a stripper, where the pressure is reduced and hot gas oil introduced to flux the asphalt. Recovered propane passes back to storage. Propane solution of deasphalted oil leaves the settler through a back-pressure regulator, is mixed with acid sludge and passes to a sludge settler. Sludge is removed continuously, and is mixed with gas oil as it enters a stripper wherein live steam decomposes the sludge and vaporizes the propane. Steam and propane pass overhead to a neutralizing jet condenser, where steam is condensed and the vapour freed of SO_2 by contact with water and caustic. Decomposed sludge is treated for recovery of acid. The partly treated oil leaving the first sludge settler is mixed with fresh acid and passed to a second sludge settler. Acid sludge removed from this settler is used for treating in the first settler. The treated oil solution from the second settler is neutralized with dilute caustic in an orifice mixer and passes to a caustic settler. The caustic solution removed is used to neutralize the vapours from the sludge stripper. The neutralized oil is split into two streams, so that about two-thirds passes through two steam heaters and then to the oil flash-tower below the bubble trays, whilst one-third goes directly to the flash-tower above the trays. The vapours pass to the propane condenser, whilst the oil enters a stripper, where the last traces of propane are removed by steam. Water is finally removed from the treated oil in a dehydrator. The treating equip-

ment can be by-passed when deasphalting only is required. Special precautions to avoid corrosion and undue leakage of propane in the system are described. Quite considerable savings in cost of treatment and in loss are claimed as compared with conventional methods, and the quality of product is equal and in some respects superior to that produced by the older methods. R. A. E.

1373. Adulteration of Mineral Lubricants with Vegetable Oils. A. Balada. *Petr. Z.*, 22.9.37, **33** (38), 1–8.—Results are given of Air Ministry oxidation tests on vegetable oils and on their blends. J. W. J.

1374. Reaction between Bearing Material and Lubricant. T. Ranow. *Petr. Zeit.*, 8.9.37, **33** (36), 1–8.—Different bearing metals with the same oil show differences of friction and temperature rise in a testing machine when other conditions are held the same. Plotting temperature rise against surface pressure shows plainly the change from liquid friction condition. The curve up to this critical pressure, which is nearly the same for all the oils, can be expressed: temp. rise $= C_1 \times (\text{pressure})^{C_2}$. The product C_1C_2 plotted against the ratio initial m.pt. of metal to fl. pt. of oil gives a smooth curve. The effect is presumably due to the interplay of molecular forces. No similar relation can be found for the part of the curve above the critical pressure. The metals of finer structure give better performance. J. W. J.

1375. Patents on Lubricating Oil. H. D. Elkington. E.P. 468,695, 6.7.37. Extraction and washing systems for the refining of lubricating oil by means of selective solvents.

C. C. Wakefield & Co., Ltd., and G. H. Thornley. E.P. 469,889, 4.8.37. Anti-corrosive lubricant consisting of a blown fatty oil or wool-wax and one or more of the soaps of Al, Ba, Ca, Cr, Co, Cu, Fe, Pb, Ni, K, Na, Th or Zn which is capable of absorbing liquid or vapour to form an emulsion in which the oil is in the continuous phase.

G. W. Johnson. E.P. 470,078, 9.8.37. Manufacture of high-grade lubricating oils by treating asphalt-base crudes or their fractions of high b.pt. with liquefied propane.

Ruhrchemie A.-G. E.P. 470,534, 17.8.37. Production of lubricating oil by cracking conversion products boiling above 150° obtained by the catalytic hydrogenation of CO at 450–550° C. and under 8–15 atms.; the resulting hydrocarbons rich in unsaturateds are then condensed in the presence of aluminium chloride.

N.V. de Bataafsche Petroleum Mij. E.P. 470,580, 18.8.37. Condensation products obtained by condensing polycarboxylic acids with polyhydric alcohols are blended with lubricating oils to improve their quality.

Continental Oil Co. E.P. 470,756, 16.8.37. Improvement of hydrocarbon or cutting oils by adding a small quantity of a sulphurized unsaturated organic acid containing at least 25% of sulphur in chemical combination.

N.V. de Bataafsche Petroleum Mij. E.P. 471,213, 31.8.37. Splitting up mixtures of hydrocarbons of high mol. wt., by means of solvents, *e.g.* propane.

F. W. Sullivan, Jr., W. H. Bahlke and A. A. Brown. U.S.P. 2,091,400, 31.8.37. Solvent extraction of lubricating oils using a β-chlorinated aliphatic ketone containing not more than 6 carbon atoms.

J. F. Schulze. U.S.P. 2,088,616, 3.8.37. Vacuum distillation of lubricating oils.

J. C. Black and M. L. Chappell. U.S.P. 2,091,624, 31.8.37. Dewaxing of hydrocarbon oils using propane and butane.

E. B. McConnell. U.S.P. 2,091,645, 31.8.37. M. R. Fenske and W. B. McCloer. U.S.P. 2,091,917, 31.8.37. Extraction apparatus.

J. H. Vital. U.S.P. 2,092,436, 7.9.37. Apparatus for re-refining used oil.

W. J. D. Van Dijk. U.S.P. 2,092,739, 7.9.37. Solvent extraction of hydrocarbon oils using chlorquinoline or nitropyridine.

E. R. Birkhimer. U.S.P. 2,092,748, 14.9.37. Solvent extraction of hydrocarbon oils using phenylmethanol.

W. P. Geo. U.S.P. 2,092,968, 14.9.37. Improved filtration apparatus for dewaxing.

F. H. Franklin and T. E. Aldham. U.S.P. 2,093,430, 21.9.37. Filter for used oil adapted to be placed in the flow line of an engine consisting of a porous material which allows the passage of oil, and an alkylol amine impregnating the said material.

H. T. Bennett and D. B. Mapes. U.S.P. 2,093,538, 21.9.37. Dewaxing of hydrocarbon oil using a mixture of 2-ethylhexanol and acetone.

W. J. Podbielniak. U.S.P. 2,093,645, 21.9.37. Counter-current extraction apparatus. W. S. E. C.

Fuel Oil.

1376. Patents on Fuel Oil. G. W. Johnson. E.P. 470,072, 5.8.37. Fuel for heavy oil engines consisting of pressure extracts and residues from destructive hydrogenation of coal, peat, etc., which are rich in resins and asphalts—stabilized by the addition of small amounts of organic nitrogen compound and/or cyclic organic hydroxy-compounds. W. S. E. C.

Asphalt and Bitumen.

1377. Constitution of Cracked and Uncracked Asphalts. E. S. Hillman and B. Barnett. *Refiner*, 1937, **16** (8), 362. Chemical evidence is given supporting the conclusion reached from the rheological properties of cracked asphalts that their greater degree of dispersion as compared with straight-run asphalt can be accounted for by the greater aromaticity of the malthenes. The investigation was carried out on a Dubbs low-level residue from a Californian crude and a straight-run residue of approximately the same viscosity from the same crude. A graded series of solvents of increasing internal pressure ranging from *iso*pentane to pyridine was used, and complete analyses, specific gravity and average mol. wt. determinations were made on the various solvent fractions. The greater aromaticity of the cracked asphalt was shown by the higher specific gravity of the cracked fraction for the same mol. wt. and by the fact that precipitates of the same mol. wt. were obtained at higher internal pressure of the solvent for the cracked product. It was possible to sulphonate the Dubbs cracked malthenes to almost complete solubility in water, but the straight-run malthenes were not attacked. This suggests that the straight-run asphalts contain wholly paraffinic molecules as well as paraffin chains attached to aromatic or naphthenic nuclei, whereas the cracked asphalts only contain the latter. The theory is advanced that asphalts, particularly cracked asphalts, are built up of two- to six-membered ring units in a chain formation, and that the chain molecules form a compact ball structure in which the chain is rolled up on itself. G. R. N.

1378. Patents on Asphalt. Socony-Vacuum Oil Co., P. L. Smith and A. H. Boenau. E.P. 470,864, 24.8.37. Asphalt production by admixing residual petroleum stock with two or more solvents, separating the solvent tar containing primarily naphthenic constituents and subjecting it to steam-blowing with a gas containing free oxygen.

F. Jacobsohn. U.S.P. 2,093,450, 21.9.37. Production of bituminous and tar materials by blowing with oxygen a mixture of different bituminous materials together with 0·2–3·0% by wt. of H_2SO_4 in order to form sulpho-acids during the reaction. W. S. E. C.

Special Products.

1379. Patents on Special Products. Deutsche Hydrierwerke, A.-G. E.P. 470,849, 16.8.37. Manufacture of hard wax or resinous condensation products by heating octadecanediol, pentatriacontanol or hardened castor oil above 100° C. with *ortho*-boric or *ortho*-phosphorous acid or their anhydrides in the presence of CO_2 and a condensing agent.

W. H. Hampton and J. T. Rutherford. U.S.P. 2,094,270, 28.9.37. Preparation of odorant for gaseous fuels by fractionating the oils obtained by hydrolysis of the sludge produced in the acid treatment of low-boiling petroleum oils. W. S. E. C.

Detonation and Engines.

1380. Correcting Diesel Performance to Standard Atmospheric Conditions. C. F. Taylor. *J.S.A.E.*, 1937, **41**, 312–314.—Using a single-cylinder sleeve-valve C.I. engine, the author investigated the effect on power output of variations in atmospheric temperature and pressure at different fuel-pump settings. The results are graphically illustrated, and the main conclusions reached from the experiments are :—

(1) The effect of a change in atmospheric pressure or temperature increases with the fuel–air ratio, and is very small with low fuel–air ratio.

(2) At constant fuel–air ratio the performance varies in a similar manner to that of the Otto cycle engine. Empirical formulas might be developed for correction of diesel engine performance to standard atmospheric conditions at a given fuel–air ratio if the work were carried out on a large number of C.I. engines of varying designs. C. H. S.

1381. Future of the Erren System. Anon. *Fuel Economist*, 1937, **12** (143), 407–409.—The Erren system of operating I.C. engines on gas fuels containing hydrogen as one of their constituents aims at overcoming the disadvantages of the normal methods of this type, such as power output and flexibility of control. Three years' research by the Erren Engineering Co., Ltd., and William Beardmore & Co., Ltd., is claimed to have produced satisfactory results. The system injects gas under pressure during the compression stroke and power output is controlled by varying the admission of the gas with a patent valve. The air charge remains constant.

Any petrol, heavy oil or gas I.C. engine may be converted to this system, and, so converted, may be run either normally or with gas fuel. The advantages claimed for the system are: high brake thermal efficiency, low running costs, rapid acceleration, and a high starting torque. As an example, it is said that the effect of converting a petrol or a heavy oil engine to take hydrogen is to raise its brake thermal efficiency from about 23% with petrol and 32% with oil to roughly 40%. Coal gas may be used without loss of power or efficiency compared with petrol.

Conversion of a 4-ton lorry costs £80, including two gas cylinders, with a capacity of about 85 cubic metres, giving a range of about 50 miles.

It is stated that for every ton of imported petrol supplanted by home-produced hydrogen, 6 tons of coal would be used. The promoters advocate that the Erren system would release petrol and oil for storage for the fighting services. It is recognised that any extensive adoption of this system entails the construction of a network of pressure gas-filling stations. T. C. G. T.

1382. Steam Versus Diesel Locomotives. Anon. *Fuel Economist*, 1937, **12** (143), 398.—The British locomotive industry should obtain great benefit from the new locomotive-testing station to be constructed at Rugby by the L.M. & S., and L. & N.E. Railway Companies, at a cost of about £150,000.

While the performance of diesel-engined locomotives has received much praise and publicity, it is claimed that the recent acceleration of British railway services has shown that the steam locomotive is more suited to our needs. The latter is also claimed to be quite as fast as, and to possess more tractive power than, the diesel locomotive. The improved performance of steam locomotives is illustrated by several notable speed achievements of recent date. T. C. G. T.

Coal and Shale.

1383. Esthonian Shale Oil Industry. W. Lindquist. *Tekn. Tidskr.*, 11.9.37, **67** (Kemi No. 9), 71–75.—According to Esthonian law, all natural resources are public property, and concessions are required to mine the shale deposits, Kukersit, occurring on the rocky northern coast. Since 1918 concessions have been granted twelve

operators, and 6,678,000 tons have been mined. This shale is unlike that found in other countries, and must be treated by special methods. The organic matter, between 31·7 and 46·6% of the moist shale, has the following elementary composition: C 76·5–76·8%, H 9·1–9·3%, N 0·2–0·3%, S 1·7–2·2%, Cl 0·5–0·7%, and O 10·5–11·6%. When heated out of contact with air, gas evolution begins at 200° C., and at 360° C. oil appears. The oil evolution, most intense between 400° and 450° C., is completed at 500° C.

The shale as such is to some extent used as fuel, 422000 tons, representing 25·6% of Esthonia's solid fuel requirements, having been consumed in this way during 1936. The Tallinn Gas Works process a certain amount of shale, which yields a high-quality gas, but because of high prices obtainable for coke, gas production from coal is more economical. It is stated that when the Esthonian oil industry operates on full schedule, a large amount of high-quality gas from cracking and distillation will be available for heating and illuminating purposes.

Since oil products can be exported, and are independent of the limited internal market, the most important use of shale is in connection with oil production, three methods of manufacture being employed. (*a*) Direct application of heat by combustion of gas generated from the coke residue of the shale, used by "Esimene Eesti Põvlevkivitõõstus," works constructed by Julius Pintsch, Berlin, and operating with a capital of £335,000. The yearly production of 30,000 tons is estimated to be doubled by 1938. The yield is 18%, moist shale basis, specific gravity 0·970–0·990, flash 83° C., viscosity 5·7 Engler at 50° C., S about 1%. Most of this oil is sold directly as fuel and impregnating oil, but is to an increasing extent refined to gasoline. (*b*) Indirect application of heat as utilized by the "Esthonian Oil Development, Ltd.," and "The New Consolidated Gold Fields, Ltd." To avoid adherence to the sides of the rotating ovens, only high ash shale is processed by the latter group, capital £170,000, in Davidson retorts, yielding 18–20% of oil, yearly production 12,000 tons. (*c*) Heating by circulating distillation gases, which, in turn, are heated by means of radiators. This process is very similar to the Scandinavian tunnel ovens, frequently employed in production of charcoal, and is used by the "Eestimaa Õlikonsortsium" and "Esti Kiviõli," capital £155,000 and £645,000, respectively, yearly production 15,000 tons (2400 tons gasoline) and 65,000 tons (10,000 tons gasoline), respectively. This process, on account of a certain amount of cracking, arising from contact of distillation gases with the hot radiators, yields about 16% light fractions. The total yield on the moist shale is about 19–20%.

The high ash content of the shale, 50–60%, is of a ceramic character, and can be used for production of various types of mortar and brick. The proximity of the shale districts to the coast gives promise to the further development of this feature. The oil-shale business is stated to be the most important of Esthonia's national industries, at present employing 5000 workmen. It is further stated that this industry renders Esthonia independent of imports of both coal and oil products, and the production has already exceeded the internal consumption and given rise to export business. During 1936 a total of 11,500 tons fuel oil and 3000 tons gasoline were exported.

R. F. S.

1384. Oil From Coal. Anon. *Fuel Economist*, 1937, **12** (143), 397.—This article summarizes projects for four new carbonization plants. The South Wales Coalite Company, a subsidiary of the Low-Temperature Carbonization Co., has acquired two mines near Bridgend and is erecting a plant to carbonize 500 tons of coal per day in approximately one year's time. At Seaham Harbour, Modern Fuels, Ltd., has taken over the plant of Coal & Allied Industries, Ltd., and is to instal a battery of fifty-one low-temperature ovens, capable of producing 230 tons of smokeless fuel per day. At Dartford, Messrs. Catalysts, Ltd., plan a plant of 200 tons daily capacity. In this process the coal is ground, mixed with about half its weight of oil from previous runs, and the mixture retorted at about 600° C. Part of the oil resulting from distillation is passed through a catalyser at atmospheric pressure and partly converted into crude spirit, the unconverted oil being used in subsequent charges. The type of yield claimed per ton of coal is: smokeless fuel, 15½ cwts.; refined spirit, 10 galls.; cresylic acid, 2½ galls.; gas, about 4180 cu. ft.

The catalyst is said to have a long life and to be easily revivified.

The British Coal Distillation, Ltd., are about to erect a plant at Nottingham capable

of distilling 450 tons of coal per day. This plant should be completed at the end of 1938. T. C. G. T.

Economics and Statistics.

1385. Petroleum in the Economics of Chile. Parts 1–3. T. G. Guevara. *Mon. Petr. Roum.*, 1937, **38**, 1347–1353.—This article opens with a discussion of the country, giving a brief *résumé* of its geography, climate, population and history. The second part deals with the currency system in use, and a description of the main banks and an analysis of the last budget are given. The third part discusses the following industries: agriculture, minerals, natural salts, and fishing.

As regards the petroleum industry, drilling has so far failed to reveal the presence of oil in commercial quantities. Work has been done mostly in the islands of the south where the usual signs have been noted. The Government is in charge of the search, and proposes to spend about 40 thousand dollars (U.S.A.) this year.

Bituminous shales exist in large quantities, but their exploitation is not at present commercially sound. In the province of Antofagasta there are about 8½ million tons of shale, which would yield between 7 and 16% of crude oil. In the province of Cautin there are deposits calculated at 200 million tons at least (another estimate gives 700 million), which are expected to yield 20 litres (4½ gallons) of crude oil per ton.

Chile is therefore looking round for other sources of oil close at hand, and the St. Martin Company has been formed to exploit a field just over the Argentine border in the province of Mendoza. No information as to probable yield is yet available.

W. E. J. B.

1386. Proved Oil Reserves in United States of America. J. E. Thomas. *Bull. Amer. Assoc. Petr. Geol.*, 1937, **21**, 1088–1091.—On 1st January, 1937, a large committee, having access to much specialized information, estimated the proved reserves of crude petroleum in the United States at 13,063,000,000 brls. A similar estimate of reserves was also prepared by a committee on 1st January, 1935, who gave a figure of 13,632,000,000 brls. Details of these two estimates are tabulated.

The author believes the 1937 estimate to be a rather conservative one and suggests a figure of 15,000,000,000 brls. for fields now known. G. S. S.

1387. Oil and Shale in Bulgaria. Anon. *Petr. Times*, 11.9.37, **38** (974), 328.—A summary of the oil and oil shale prospects in Bulgaria is given in a pamphlet (price 1*s.* 1*d.*): "Report on Economic and Commercial Conditions in Bulgaria," (H.M. Stationery Office publication). R. O. Y.

BOOK REVIEWS AND BOOKS RECEIVED.

Book Reviews.

PETROLEUM DEVELOPMENT AND TECHNOLOGY, 1937. Pp. 680 + index, pp. 681–689. American Institute of Mining and Metallurgical Engineers. New York. $5.

"Petroleum Development and Technology, 1937," comprises papers and discussions presented before the Petroleum Division of the A.I.M.M.E. meetings at Los Angeles, Fort Worth, and New York during the winter, 1936–1937. The publication is divided into five chapters dealing respectively with various aspects of production engineering, production engineering research, stabilization, petroleum economics, and finally a survey of the production position in each of the principal producing countries of the world.

In a short review such as this no more can be done than to point out the main points of interest and to invite the reader to a perusal of the papers themselves. The first paper in Chapter I is a progress report on the sucker-rod pump considered as a vibrating system with one degree of freedom, with forced vibrations and with viscous damping. An interesting paper follows on the determination of fluid level in oil wells by the pressure-wave echo method using a depthograph. The remainder of the first section includes a theoretical dissertation on the "build-up" of bottom-hole pressures, a paper on the influence of production practices on the gravity of oil produced, in which gravity changes of the fluid within the reservoir and those brought about by methods of operation and the mechanical equipment used are discussed, a useful bibliography on acid treatment of wells and a note on electrical logging methods in locating water.

Chapter II deals with certain aspects of petroleum engineering research. The first paper is highly technical, dealing with experimental data on the flow of gas–liquid mixtures through unconsolidated sands under certain limited structural configuration of the producing sand, and, subject to these strict limitations, reaches some conclusions on well-spacing and production methods. The authors stress the limitations under which their paper is compiled. The following paper discusses oil-well behaviour based on subsurface pressures and production data in wells in certain American fields, and reaches the conclusion that a simple definite relation between the mass rate of fluid (oil, gas and water) production and the drop in pressure causing flow-through sands can be ascertained. The flow of fluids through sands is considered in the next paper on an experimental basis using small cores in a pressure cylinder, and further experiments are planned.

Those concerned with the legal basis under which producing fields operate will find much that will interest them in Chapter III, on Stabilization. Mr. Earl Oliver follows up previous papers and articles he has written on the rationalization of the Capture Law. The second paper offers suggestions for strengthening American conservation laws in the direction of drilling control and compulsory unit operation and by a re-enforcement of the Interstate Compact. The subject of proration is considered in an article on well-spacing in Texas, in which the author reaches the conclusion that for the producing industry to be established on a sound and profitable basis, a drastic decrease in the rate of drilling is required, and that the bases on which proration rates are elevated should be reviewed. The chapter concludes with two papers describing and commenting on co-operative development plans in the Buena Vista Hills field and the Kettleman Hills North Dome field, the degree of success they have achieved, and points out some revisions considered necessary.

Chapter IV deals with Petroleum Economics. The first paper deals with future supply and demand and the stock position as at the end of 1936. The following paper reviews previous reserves estimates and the present position, from which the author believes that a 3% average annual increase in consumption over the next decade is at least a reasonable and, probably, a somewhat conservative assumption. A paper on various aspects of oil-stock prices should be read in conjunction with those dealing with stabilization in Chapter III. Two papers follow dealing with the supply and demand of oil and oil products in California. A paper on developments in petroleum marketing will be of especial interest to those engaged in the distribution side of the industry.

Chapter V is concerned with the statistical position in the major producing states and countries.

In conclusion, the papers continue the high standard we have learned to expect, and will well repay careful reading. H. W. HOLE.

THE FIRST HUNDRED YEARS OF THE GEOLOGICAL SURVEY OF GREAT BRITAIN. Sir John Smith Flett, K.B.E., D.Sc., L.L.D., F.R.S. Pp. 267 + plates XIII + index, pp. 269–280. H.M. Stationery Office, London, 1937. 7*s.* 6*d.* net.

Seldom can a more fascinating volume have come into the hands of the geologist than Sir John Flett's Centenary Volume "The Geological Survey, 1835–1935." Just as it is good to look back from time to time and review progress along any line of research and work, so it is especially refreshing to forget for a little the almost paralysing specialization of the geology of to-day and browse on its beginnings and broad development.

There can be few publications which give us a better opportunity of thus delving into the past, since a history of the early days of the Survey is in many respects synonymous with the early history of geology itself. At the same time, the author has throughout succeeded in incorporating a vast amount of detail in the 196 pages devoted to this history of a hundred years.

Part I of the volume consists, after a Prefatory Note by Sir John's successor to the Directorship, the late Dr. Bernard Smith, of a chapter on the Antecedents leading up to the first Geological Survey ever formed, followed by seven chapters devoted to the progress and work of the Survey under each of the seven Directors who spanned its first hundred years—De la Beche, Murchison, Ramsay, Geikie, Teall, Strahan and Flett.

Part II of the volume deals in greater detail with a much shorter period—namely, the opening of the new Museum of Practical Geology on 3rd July, 1935, by His Majesty the King, then H.R.H. the Duke of York, followed by a full account of the Centenary Celebrations.

It is impossible in writing of such a publication to do more than touch on a subject here and there almost at random. What must first strike the reader was the rapidity of the advancement of Geological Science once such early workers as Hutton, Playfair and Lyell had broken away from the old catastrophic theories of geology and William Smith had laid the foundations of true geological mapping.

Once the Geological Survey was formed, thanks to the initiative of De la Beche and the support of the Geological Society, systematic work went forward at an amazing rate. It is interesting to note, especially in view of present-day conditions, the keen interest evinced by the first Director in the economic side of the science, and before his death in 1855 he had under his direction not only the Survey itself, but also the Museum of Practical Geology, the Royal School of Mines and the Mining Records Office, all owing their origin to his personal initiative.

In the subsequent chapters Sir John outlines the development of the Survey work under each successive Director, weaving skilfully into each chapter an excellent character-study of his predecessors and detailing the more important activities of the various members of the Survey staff throughout each period. Coming to his own tenure of office, Sir John obviously writes at a certain disadvantage, and in comparison with the more vivid style of the earlier chapters, it inevitably strikes one as more of a cold statement of facts.

In reading Part I and in looking over the Staff List which forms Appendix II one cannot but be impressed with the rôle that the Survey has played as a training-ground for geologists. We see how many of those who have filled academic posts at home and abroad, founded and staffed Geological Surveys overseas or have been the pioneers of the vast development of economic geology are old "Survey men."

The thanks of all geologists are due to the author for giving us such an admirable history of a service of which this country as the pioneers of Geological Science is justly proud. J. ROMANES.

HANDBOOK OF CHEMISTRY. M. A. Lange. 1750 pages of text, 30 pages of index. Handbook Publishers Incorporated, Sandusky, Ohio. 1937. $6.

Lange's "Handbook of Chemistry" is the second edition of a reference volume on chemical and physical data which was first published in 1934. The first edition was reviewed in the *Journal* of the Institution, and it was then noted that this reference volume is larger than a number of other handbooks; the second edition has been enlarged,

the additional material has been carefully considered, and includes tables dealing with organic ring systems, melting points of organic compounds arranged in ascending order, refractive indices, properties and composition of denatured alcohol illustrating the high range of formulas permitted in the United States. In addition to the tables usually included in a handbook of this character, tables on hazardous chemicals, first-aid measures for accidents and antidotes for poisons, definitions of pharmaceutical preparations and therapeutical terms, and very complete tables of conversion factors are given, and also an Appendix of 250 pages, of which 94 pages cover mathematical formulas and equations and the rest mathematical tables.

The book naturally is written very largely from American experience, and certain of the tables are, for this reason, of less value elsewhere, such as those relating to the combustion and heating value of coals, water analyses, and pipe fittings, but these represent only a very small percentage of the book.

The section on viscosity on page 1343 requires complete revision, as it states that in the case of Saybolt viscosities, *kinematic viscosity in poises* can be calculated from the Saybolt time in seconds. The A.S.T.M. Committee D-2, in their 1936 and 1937 reports, issued tables for the conversion of Saybolt Universal viscosity into kinematic viscosity expressed in centistokes. The table on page 1495 for the conversion of Saybolt, Redwood and Engler viscosity determinations is also inaccurate, and should be amended to include consideration of the tables issued by the Institution of Petroleum Technologists for the Redwood viscometer early in 1936, in which, for the first time, conversion factors for use at different temperatures were given for a commercial viscometer. It would have been desirable to have quoted the viscosities of various liquids (pp. 1343 *seq.*) in centistokes rather than in the dynamic units of millipoises.

As an illustration of the completeness of the tables, that giving the physical constants of organic compounds includes nearly 4500 compounds, and is supplemented by an index to melting points arranged in ascending values, and also by a formula index arranged as in Richter.

A considerable amount of material of value to chemical engineers is also given, comprising properties of materials for construction and insulation, and tables on flow and temperature measurements.

Lange's "Handbook on Chemistry" can be thoroughly recommended as a reference volume owing to the completeness of the information which it gives, and this completeness is largely due to the care taken in selecting the supplementary information additional to that usually included in this type of handbook. F. H. GARNER.

Books Received.

U.S. GEOLOGICAL SURVEY BULLETIN 879. GEOLOGY AND MINERAL RESOURCES OF THE BAKER QUADRANGLE, OREGON. J. Gilluly. Pp. 119 + 2 folding maps. Superintendent of Documents, Washington, D.C. 65 cents.

This report presents the results of a reconnaissance of the Baker quadrangle, Oregon, carried out during brief studies of some mining districts in and near the area. The rocks of the quadrangle may be divided into two groups: (*a*) pre-Tertiary, and (*b*) Tertiary and Quaternary. The mineral resources of the area include deposits of gold and silver, copper, manganese, tungsten, asbestos, coal, diatomite and building stone.

CANADA DEPARTMENT OF MINES AND RESOURCES. No. 776. INVESTIGATIONS IN ORE DRESSING AND METALLURGY, JULY TO DECEMBER, 1936. Pp. 204. Bureau of Mines, Ottawa, Canada.

B.S.S. No. 753. "BRITISH STANDARD DENSITY—COMPOSITION TABLES FOR AQUEOUS SOLUTIONS OF SULPHURIC ACID FOR USE IN CONJUNCTION WITH BRITISH STANDARD DENSITY HYDROMETERS." British Standards Institution, 28, Victoria Street, S.W.1. 3*s.* 6*d.* net.

B.S.S. No. 240. "BRITISH STANDARD METHOD AND TABLES FOR BRINELL HARDNESS TESTING." Pp. 24. Revised September, 1937. British Standards Institution, 28, Victoria Street, S.W.1. 2*s.* net.

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Geology.

1388. Inorganic Origin of Petroleum. F. Sacco. *Riv. Ital. Pet.*, Sept., 1937, **5** (53), 7–9.—The facts and environmental conditions which suggest either an inorganic or an organic origin for petroleum are reviewed, and the familiar arguments, *pro* and *con*, are reiterated.

Although it is possible that petroleum has been produced in nature, as in the laboratory, from both organic and inorganic material, the author concludes that there is a strong case for assuming, in general, a deep-seated, inorganic origin for crude oil. It is suggested that petroleum, as now found, has reached its present, largely sedimentary, environment by migration from depth during periods of active earth-movement. L. O.

1389. Correlation of Earth Resistivity with Geological Structure and Age. R. H. Card. *Amer. Inst. Min. & Met. Engrs., Tech. Pub.* No. 829, 1937, p. 19.—Evidence is given to show that the increasing effective resistance of rocks corresponds roughly to their increasing age, ranging from 2 to 30 metre-ohms for the youngest up to 1000 to 14,000 metre-ohms for the oldest formations. The presence of igneous rocks among comparatively young strata augments the effective resistivity, whereas local alluvial deposits lower the resistivity greatly. Correlation with age is based on the fact that the resistivity of a particular material is chiefly dependent on its pore volume and the amount and composition of the interstitial water. As diminution in pore volume is a general concomitant of increasing age in sedimentary rocks, it follows that Pre-Cambrian formations commonly reveal the highest resistivities. Wide and erratic effective resistivities are to be expected among ancient rocks, while the usually simpler structures of young strata conduce to their comparatively uniform resistivity.

Typical statistics indicate that the depth to which strata should be considered at any particular place varies with the local effective resistivity and with the frequency of the test current. The paper concludes with some correlation data relating to specific areas in the U.S.A. D. W.

1390. Geology of Petroleum at the 2nd Natural Sciences Reunion (Mendoza, B.A., April 3rd to 11th, 1937). E. Fossa-Mancini. *Bol. Inform. Petroleras* (*B.A.*), May, 1937, **14** (153), 33–41.—Among the many communications read to the Geological Section, that of Dr. Groeber, on the Geology of Mendoza, deserves especial notice. With reference to the Cacheuta petroleum, he considers that the mother rock must be looked for in the Carboniferous bituminous shales, in spite of the fact that the oil is normally associated with bituminous shales containing *Estheria*. This hypothesis lends a special interest to the post-Carboniferous thrust structures of the pre-Cordillera in which strata of Devonian or Silurian age have overridden Carboniferous beds.

The paper describes two excursions run in connection with the Congress, and is illustrated by seven photographs. L. O.

1391. Some Preliminary Notes on the "Strata of Malargüe." P. Mühlmann. *Bol. Inform. Petroleras* (*B.A.*), May, 1937, **14** (153), 42–56.—The object of the author is to complete the collection of fossils made by Dr. Boehm, and the paper describes specimens found in the type sections in the Pequenco river, Pampa Amarilla and Chachao hill. The "Strata of Malargüe" (so named by Gerth) are marine in character and lie in apparent conformity on the Cretaceous "Red Sandstones"; the age of the different horizons has not been determined, up to the present, owing to rapid lateral variation and lack of fossils at certain horizons. Overlying them, in the Pircala syncline, are found unfossiliferous continental beds which are stated to be contemporaneous with the Upper Cretaceous of Cacheuta.

The strata of the Arroyo Pequenco zone are described and the fossils catalogued. Boehm, on lithological grounds, has divided the "Strata of Malargüe" into three sections: Lower (chiefly oolitic calcareous sandstones with green layers); Middle (limestones and deep-water marls); and Upper (somewhat calcareous sandstones). These divisions correspond approximately, but not exactly, to the palæontological divisions.

The Pampa Amarilla and Chachao lithology and palæontology of the Malargüe strata are described and the local characteristics noted.

Petrographically, the Malargüe beds are characterized by their content of carbonates and volcanic glass. The tuffs vary in colour from malachite-green to pale grey-green; they have been wrongly described as glauconitic sandstones. In some cases felspars (orthoclase and plagioclase) are predominant.

The paper is illustrated by a map, a comparative chart of the exposures at twelve localities ranging from Cañada la Paja to Agua del Lechuzo, the Arroyo Pequenco column being taken as typical.

A photograph and six photomicrographs are included. L. O.

1392. Geological Application of Oriented Coring. A. B. Patterson and J. K. Butler. *Oil & Gas J.*, 28.10.37, **36** (24), 46.—The early methods of oriented coring fall roughly into four classes: the core is oriented by orienting the rods or drill-pipe out of the hole, as in the Kind method; an instrument is attached to the core and then withdrawn from the hole, as in the Vivian method; a recording instrument is attached to the core barrel while the core is out, as in the Gotham method; the wall of the hole is photographed with a special camera, as in the Atwood method.

The McReady device now used has an orientation core drill with a bronze drill collar, an inner barrel swivel within the outer barrel, and a photographic recording instrument which is carried on the inner barrel. The instrument records the position of the core barrel at regular intervals during coring, and from this record the dip and direction of dip can be determined after the core has been withdrawn.

The second method employed at present requires the cutting of a core which is firm enough to allow trimming and sizing, and has sufficient lamination to show the dip of the beds. The north and south poles of the residual magnetism are determined, and thence the direction and angle of dip. This method has given good results with hard formations, but seems not to be particularly accurate in soft beds, as on the Gulf Coast. The incoherency and absence of bedding planes render determinations difficult.

The application of oriented coring provides very valuable data in wildcat wells, on faulted structures, and in drilling around piercing salt domes. G. D. H.

1393. Influence of Connate Water on Estimation of Oil Reserves. R. L. Ginter. *Oil & Gas J.*, 7.10.37, **36** (21), 97–100, 105.—The presence and amount of interstitial water in oil sands are discussed. The degree of contamination of cores by water from the drilling fluid has been determined by drilling with oil and also by adding a known percentage of dextrose to the mud, and then estimating the dextrose content of the core. It is shown that the interstitial water may be as much as 50 or 60%. Grain size is important. The effect of a thin film of water around the sand grains is considerably greater in the case of fine grains than in that of coarse. In the calculation of oil and gas reserves, based on the porosity of the sand, this interstitial water must be taken into account. Neglect of it results in apparent recoveries which are too low. S. E. C.

1394. Petroleum Developments this Year in the Illinois Basin. A. H. Bell. *Oil & Gas J.*, 21.10.37, **36** (23), 28–30.—Studies of the stratigraphy by the State Geological Survey, together with geophysical prospecting, have proved the presence of structures favourable to oil accumulation in the Illinois Basin, and several new productive areas have been discovered during the past few years.

Most of the production is from the McClosky Sand, a light grey oolitic horizon in the St. Genevieve Series. In many localities it has an exceptionally high porosity owing to the lack of cementing material. Accumulation is not entirely governed by structure, because the McClosky is lenticular, and production may be expected well down the flanks of the structures. J. A. G.

1395. Geology and Economic Significance of Hastings Field, Brazoria County, Texas. M. T. Halbouty. *World Petr.*, Sept., 1937, **8** (9), 36–51.—The Hastings field is located on an uplift extending in an E.–W. arc from the Genoa area, through Friendswood,

Hastings and Manvel. Except for Genoa, all these areas are productive, and separated from each other by faulting or synclinal conditions.

A deep-seated salt dome with a maximum uplift of 1025 ft. probably underlies the Hastings field. The formations are broken by a regular series of faults comprising two systems, the major one trending N.W.–S.E., and the other N.E.–S.W. The author considers that migration started soon after movement of the salt began, and normal accumulation was complete before the structure was subjected to faulting. A graben was formed which crosses the dome in a N.W.–S.E. direction, and the area to the west, which was originally not high enough on the structure to contain free gas, was thrown higher than the rest of the dome. Secondary migration took place, and the throw of the faults was such as to enable oil but not gas to migrate from the graben sector into the western area. Thus the oil in the latter area is without a gas cap, but on the eastern side of the graben both oil and gas overlie the water.

Production is from the Frio Sand of Lower Oligocene age at a depth of about 5990 ft. It has a maximum thickness of 1025 ft., and the sand beds are broken by bands of shale. Porosity varies in different parts of the field, but the average is estimated at 30%, with a saturation of 80%. The author estimates the total reserves at 520,284,000 brls., this figure being based on a recoverable factor of 800 brls. per acre foot.

A brief outline of production and drilling methods is given, together with numerous maps, sections, and other illustrations. J. A. G.

1396. Heyser Extension Considered Important Potential Reserve. F. L. Singleton. *Oil & Gas J.*, 4.11.37, **36** (25), 21.—The Heyser field lies about 15 miles west of Port Lavaca, Texas, and began producing early in 1936 from the Frio Sand (Lower Oligocene) at a depth of from 5460 to 5499 ft. The structure is believed to be a deep-seated salt dome with few signs of faulting. Wells recently drilled on the western and northern sides of the structure have found the gas and oil sands to be lenticular, and in some cases the gas sand is entirely absent. Additional wells will be drilled farther north, and it is expected that the present producing area will be increased from 3000 to 6000 acres. Recovery has been estimated at 8000 brls. per acre, and ultimate total recovery is calculated as 48 million brls. J. A. G.

1397. Louisiana Discovery Opens Possibilities. L. G. E. Bignell. *Oil & Gas J.*, 30.9.37, **36** (20), 23–24.—A test well recently completed at 9040 ft. in Evangeline Parish has obtained production from the Sparta Sand, which is a series of interbedded sands and clays of Eocene age. The well is producing from a thickness of 63 ft. at the rate of 175 brls. per day.

The Angelina–Caldwell flexure divides Louisiana into two provinces, the productive horizons in the southern area being deeper than those in the north. In the Urania field, which is situated on this flexure, the Sparta has a 30-ft. basal section of coarse sand which shows traces of oil. This probably correlates with a 75-ft. section cored in the recent discovery well, and indicates thickening of this sand body in a southerly direction. If this is so, it may be a new source of production in the Gulf Coast area. J. A. G.

1398. Indiana Portion of Basin is Now Receiving Attention. R. E. Esarey. *Oil & Gas J.*, 28.10.37, **36** (24), 108–116.—Indiana is affected by several structural features, the most important being the Cincinnati Arch, which divides the State into two major provinces. It trends N.W.–S.E., and the formations on the S.W. side dip into the Eastern Interior Coal Basin. The angle of dip is relatively gentle, and little affected by strong folding or faulting, although several anticlinal structures are known to exist. The author points out that, while some of the present shallow fields may be due to lensing of the sand bodies or differential compaction, many of the structures discovered by seismograph work persist to depths of 6000 ft. or more, and must be of Silurian age or older.

At present, most of the production comes from the sands in the Mississippian and Pennsylvanian. The latter series attain their greatest thickness along the Illinois boundary and unconformably overlap the Mississippian from S.W. to N.E. The McClosky Sand (Lower Mississippian) has not been penetrated in many wells, but it

offers good chances of production on suitable structures. Several horizons in the Devonian and Silurian are considered even more favourably, and deep production may be possible from the Trenton Limestone. J. A. G.

1399. Moore Field is Problem Child of Oklahoma. F. B. Taylor. *Oil Weekly*, 23.8.37, 86 (11), 21–29.—The field is located on the southern end of the Nemaha Granite Ridge, and is considered to be an asymmetrical anticline with a steeply dipping or faulted eastern limb. Production, which is limited to the western flank, comes from the second Wilcox Sand and a dolomitic section in the Simpson. The former is the major producer, and is found at an average depth of 7300 ft. Both the Hunton Lime and the Viola are present, but so far they have showed no signs of containing oil or gas.

The presence of a fault is indicated by irregular lines of fracture in the Wilcox along the eastern edge of the field. These consist of intrusions of an impervious and solid material foreign to the finely-grained nature of the sand. If the presence of a fault in this position can be proved, it may be possible to correlate it with the fault limiting production in the Oklahoma City field about 3 miles to the N.W.

The oil is accompanied by large volumes of gas, and most of the wells are now producing through 2½–3 in. tubing, using bottom-hole chokes of ½ in. to ¾ in. diameter. Reservoir energy is being well maintained, and various estimates place the ultimate recovery at between 20 and 50 million brls. J. A. G.

1400. Stratigraphic Observations in North Argentine. O. Schlagintweit. *Bol. Inform. Petroleras* (*B.A.*), August, 1937, **14** (156), 1–47.—In spite of intensive geological studies in the North Argentine, particularly in the sub-Andine zone, the knowledge of the local stratigraphy is still inadequate to the needs of the petroleum industry. This lack of stratigraphic knowledge is due to several factors. The uniformity of the ground and the scarcity of key horizons may be cited. The close bush makes field correlation difficult and limits outcrops to streams.

Palæozoic. The Palæozoic nucleus of the sub-Andine ranges has been taken as consisting, as a whole or predominately, of Devonian strata, but fossil evidence now indicates that beds of Silurian age form a considerable component. The presence of beds of lower Ordovician age is also indicated. On lithological grounds, underlying quartzites are possibly Cambrian. Certain tillites, interbedded in the fossiliferous complex, are taken to be Silurian; others have been observed at various levels in the lower Ordovician.

Post-Palæozoic of Jujuy. The following classification, which retains names already accepted, is proposed, the corresponding divisions of Hagerman being added for comparison and convenience:—

Jujuy Beds	*Ts*	of Hagerman
Sub-Andine Tertiary	*Te-Ti*	„
Upper Sandstones	*U*	„
Variegated Marls:		
Upper Coloured Marl, with Green Band	*V*	„
Green Marls	*Ws*	„
Lower Coloured Marls	*Wi*	„
Dolomitic Limestone Horizon:		
Limestone	*Xs*	„
Calcareous Sandstones	*Xi*	„
Lower Sandstones	*Y*	„

The term "Lower Sandstones" (*Y*) is used in a limited sense. It does not include the Gondwana tillites, and should not be correlated with them, nor with the sandstones immediately overlying them. The "Lower Sandstones" almost invariably rest on basal conglomerates containing coarse, poorly rounded boulders. The thickness of the series varies from 1200 metres in Las Avispas to some tens of metres in the Arroyo de Santa Bárbara. In the Duranzo the series (in the limited sense defined above) is missing.

The rapid variation in thickness over short distances indicates a Palæozoic topography of considerable relief, although pronounced angular unconformity has not

been observed between the Palæozoic and "Lower Sandstone" beds. In the south, however, where the basal complex is of Pre-Cambrian age, marked angular unconformity occurs.

In certain localities the Lower Sandstones are intruded by basic rocks provisionally classed as vesicular Melaphyres or Basalts. In the Jujuy district only do they reach horizons above the Lower Sandstone, and in several localities they are completely missing.

The Dolomitic Limestone Horizon is not separated by an hiatus from the Lower Sandstones, and it is always difficult to define the junction. Conglomeratic bands possess little significance as basal markers, since the border-line deposits were terrestrial and were formed under arid conditions.

The Upper Limestone, *Xs*, division is not entirely uniform, but includes calcareous sandstones, marls, clays and even conglomerates. Except in the extreme north, where marine types of fossils are found, the *Xs* division is lacustrine in origin. It is in this series that the "Problem Fossil" of Bonarelli makes its first appearance. The *Xs* horizon varies considerably in thickness and is often missing; at Calilegua, its thickness is 200 metres, diminishing southwards to 10 metres at Moralito, and disappearing entirely before El Duranzal. It is also missing on the western slopes of the Zapla range.

The Variegated Marl Series also varies considerably in thickness, and all the evidence points to the existence of an island or peninsula at Zapla during Lower Sandstone–Variegated Marl times.

The algal "Problem Fossil" persists from *Xs* through *Wi* to the Green Band of *V*.

The Upper Coloured Marl contains abundant insect remains, especially *Coleoptera*, together with fish remains. They may be of Upper Cretaceous or Lower Tertiary age, but are certainly not Trias–Lias, as has been suggested.

The beds overlying the Upper Coloured Marl form a series of sandstones with occasional intercalated clays. They are very variable in thickness and colour; their junction with the Upper Coloured Marl is usually clear; it is often indefinite with the overlying Sub-Andine Tertiary. A time interval between the Upper Coloured Marl, *V*, and the Upper Sandstone, *U*, series is indicated.

The Upper Sandstone series is succeeded by a very thick formation—4000–5000 metres, and perhaps more in places—which consists of interbedded sandstones (often rather argillaceous), clays and marls, predominantly dark brown in colour. The appellation "Tertiary" is misleading, as the age of the Sub-Andine Tertiary series is Mio-Pliocene, but the term is retained as it is in current use.

Lateral Variation. The Jujuy stratigraphic column is taken as typical.

In the Department of Chicoana the Variegated Marl contains sandstone intercalations to an extent unknown in Jujuy. In the passage beds between Sub-Andine Tertiary and Upper Variegated Marl there occur thick, brick-red sandstones which cannot be distinguished in the field from those of the Upper Sandstone, *U*, series. The Green Marl band contains lenses of fossiliferous bituminous marl.

Travelling westwards, various lateral changes observed near San Fernando (*Q.* Escoipe), Cuesta del Obispo and Cerro Tintin are described. In the Morenillos zone the *Xs* division is missing; a stratigraphical column for this zone is given.

The Tucumán facies of the Sub-Andine Tertiary is described.

The stratigraphic column of the Department of Oran differs considerably from that of Jujuy. Here the generalized sequence from the surface downwards is: Sub-Andine Tertiary, Upper Sandstones and Calcareous Horizon outcropping, and Lower Sandstones, Gondwana beds and Blackish Slates (*Pizarras Negruscas*) encountered in wells.

The "Calcareous Horizon," mentioned above, is a conglomerate, and should not be correlated with the *Xs* of Jujuy, but is younger. L. O.

1401. Geological Investigations by Y.P.F. in the Province of Mendoza and Some Regional Stratigraphic Problems. E. Fossa-Mancini. *Bol. Inform. Petroleras* (*B.A.*), June, 1937, **14** (154), 51–118.—The work with which this paper deals is divided into two sections: (1) a concise description of the geological investigations, and (2) a discussion of some of the problems of Mendocian geology.

The history of the geological study of the province is outlined.

For the purposes of description and treatment, it is convenient to divide the province

of Mendoza into six regions: (1) Las Heras, extending from the San Juan boundary in the north to the Mendoza river in the south; (2) Cacheuta and Tupungato, between the rivers Mendoza and Tunuyán; (3) San Carlos, between the rivers Tunuyán and Diamante; (4) Sosneado and San Rafael, between the rivers Diamante and Atuel; (5) Malargüe, between the Atuel river and the 36° parallel; and (6) Payún, between the 36° parallel and the Nequén boundary.

The geology and palæontology of these districts are discussed in detail.

Stratigraphical problems, including that of nomenclature, are attacked, and the difficulties of correlation over the large areas covered by beds of continental origin are pointed out.

Petroleum is known to occur in strata of the following ages: Quaternary (Salina de Llancanela), Upper Tertiary (Tupungato), Lower Tertiary or Upper Cretaceous (Cerro Alquitrán), Upper or Middle Cretaceous (Pampa Amarilla), Lower Cretaceous (Cerro Toscal de Marlargüe), Upper Jurassic (Ranchitos on the Salado river), Middle or Lower Jurassic (Loma de la Brea near Laguna Blanca), Lower Jurassic or Triassic (Cacheuta), and in calcite veins crossing the pyroclastic beds of the Upper Palæozoic (Cerro Malal). Petroleum has also been found in Tertiary andesites (Cerro Alquitrán) and in the Lower Mesozoic vesicular lavas (Cacheuta).

Lithological correlation is usually not possible, except over areas very limited in comparison with that of the Province. From Palæozoic to Recent times five-sixths of the province of Mendoza has remained above the sea. Actually the area still represents a part of the marginal zone of the western sector of the ancient Gondwana-land, and marine beds are found only along a narrow zone at the western and southern boundaries of the province. In the rest of the area under review, either sedimentation of continental deposits, very poor in determinable organic remains, or erosion has occurred. Up to date there are no means of dividing, on a time basis, the zones of this persistently continental area in which erosion has predominated over sedimentation, or *vice versa*.

Another factor which makes correlation difficult has its origin in the tectonic incidents which occurred in late Palæozoic and early Mesozoic times. These incidents initiated systems of faults, possessing a fairly uniform orientation, and subsequent movement along these faults has continued in Mesozoic and Cainozoic times.

The sub-surface of Mendoza is thus cut up into a multitude of large blocks which, during their geologic history, have suffered considerable displacements relative to each other. It is obvious that, each time a block has been elevated, erosion has been favoured, and that, when a block has been lowered, sedimentation has been favoured. This has caused breaks in the sedimentary series which, in addition to marked lateral lithological variation, has made even tentative stratigraphic correlation insecure.

L. O.

1402. Kirkuk Oilfield. Anon. *Oil Weekly*, 16.8.37, **88** (10), 58–63.—The geosynclinal basin of Iraq is bounded on the N.E. by the Iran Mountains, on the N. by the Zaurus Mountains of Turkey, and on the W. and S.W. by the Arabian Shield. The latter acted as a buttress to folding movements from the N.E. which produced structures ranging from normal anticlines on the west, to conditions of considerable overthrust on the east. Most of the production is obtained from the Asmari Limestone below the zone of medium overthrusting. This, unlike the overlying Fars Series, was not affected by the overthrusting movements, and formed a resistant arch over which the plastic clays were thrust. The Kirkuk field is an example of this. Although erosion has exposed the Cretaceous in the N.E., in the intermediate zone it has not penetrated farther than the Fars Series, and it is assumed that the Tertiary and Cretaceous oils have been preserved in many of the structures.

The Kirkuk field contains three domes, the major one being about 10 miles long by 2 miles wide. About forty wells have been drilled on it, and fourteen of them are producing from the Asmari at depths varying from 1200 to 3000 ft. Several of the other wells have been retained for the purpose of observing reservoir conditions; the remainder have been plugged. The producing wells are not set with tubing, but completed with an 8¼-in. oil-string, the flow being controlled by a series of small pipes and valves by-passing a main 6-in. valve above the master gate. The other two domes have not yet been drilled. Production is limited to 85,000 brls. per day, and any one of the three de-gassing stations on the field can supply this quantity.

J. A. G.

1403. Geology of the Country Around Bethlehem and Kestell with Special Reference to Oil Indications. O. R. van Eeden. *Union of South Africa, Dept. of Mines; Geological Survey Memoir No.* 33 (1937), 5–60. One geological map.—The area described lies within the Orange Free State between lat. 28° to 28° 30′ S., and long. 28° to 29° E. The rocks exposed belong to the Karroo system, and include the Stormberg series and the upper part of the Beaufort series. The Middle Beaufort beds consist of coarse to medium-grained buff-and-white sandstones, overlain by bright-coloured mudstones and more medium-grained buff sandstone. The Upper Beaufort beds contain bright-coloured mudstones with medium-grained buff sandstones. The Molteno beds are of white grits and sandstone with thin shales and vegetable remains. Overlying them are the Red beds—white grits and fine-grained red-and-yellow sandstone bands in bright-coloured mudstones. Reptilian remains have been found in them. The lower part of the Cave sandstone also contains reptilian remains in the red argillaceous fine-grained sandstone. The upper part is of cream-coloured, massive, fine-grained sandstone. The uppermost beds of the Stormberg series are the Drakensberg beds—compact, amygdaloidal basaltic lavas with one or two sandstone beds near the base. The Karroo dolerites have been intruded as dykes and sheets throughout the series described, but they are more abundant in the Beaufort than in the Stormberg series.

As a whole the formations have been disturbed very little. They have a low regional dip towards the south. A few flat dome-like structures occur and low curving folds with a general N.E.–S.W. trend cross the area. Dips range from 1° to 5°, but are generally about 2°. Most of the structures are ill-defined, and in most cases it is difficult to locate the axes of folding. Some structures seem to be definitely connected with dolerite intrusions. With one exception, the faults seem small.

Small amounts of hydrocarbons have been reported in many places. Many appear to be intimately connected with dolerite intrusions, occurring either in the dolerite or in the immediately adjoining country rock. The origin of the oil may be igneous distillation of the carbonaceous sediments which are present at several horizons in the Karroo rocks, synthesis within the dolerite, or possibly collection from oil already existing in the Karroo beds. The basal part of the Drakensberg lavas also has shown solid and liquid hydrocarbons in some of the amygdales, but, as far as could be ascertained, this was not related to the proximity of dolerite dykes. The underlying porous Cave sandstone shows no oil, and the evidence seems to be that the hydrocarbons were present in the lavas when they were poured out on the surface. Their ultimate origin is undetermined, but distillation from carbonaceous rocks or synthesis within the magma are possibilities.

Reviewing the various strata, the Middle Ecca seems to be most favourable as regards source materials. However, further consideration shows that there does not seem to be much hope of striking oil in commercial quantities in the northern part of the Karroo basin, the reasons being: (*a*) absence of any real oil seepages; (*b*) the failure of the many bore-holes drilled; (*c*) the undisturbed condition of the Karroo system as a whole; (*d*) sundry other reasons, such as the continental nature of the sediments and the high "carbon ratios" of the Ecca coals. G. D. H.

1404. Oil in France. C. Finaton. *Rev. Petr.*, 15.7.37 (744), 1077–1081.—The author remarks that, while since 1923, 132 oil-prospecting licences have been taken out, in two cases only did they reach the concession stage—at Gabian and at Vaux-en-Bugey.

Oil signs exist in the following regions: the Sub-Pyrenees, the Mediterranean coast and Jura region, associated with lagoonal Triassic deposits; while in the Limagne, Rhine Graben and Genevan regions with Upper Oligocene to Lower Miocene associations. With regard to the extent of the investigations and drilling in these regions, in the Sub-Pyrenees drilling has been unsuccessful, but the geology is complicated, and further search seems justified. In the Gabian region some commercial oil has been found, but in a very limited region. At Pézenas, near Gabian, a well is now drilling. In the Alpine region, despite interesting indications, no serious work has been done. In Limagne several unsuccessful shallow wells have been drilled, while in the Geneva region wells have met with impregnated zones. In the Rhine Graben no important structures have been found with the exception of Pechelbronn, but recently impregnations near fault zones in the Jurassic and the discovery of a new deep zone in the Trias suggests that there are now possibilities in this region.

So far search for oil in France has lacked method and thoroughness, so that even the tested regions cannot be justly condemned. Drilling has been quite considerable, but much of it very shallow and unscientific. Present activity may be summarized: (1) exploitation of Pechelbronn and the new important deep zone, (2) Pézanas and Frangy test wells for Triassic production, (3) gas exploitation in the Vaux region.

R. O. Y.

1405. Oil Possibilities of the Trias of Lorraine. C. Finaton. *Rev. Petr.*, 1.10.37 (753), 1381–1385.—This region has been neglected in the past search for oil in France, but in view of the recent discovery of Triassic oil in Pechelbronn it is worthy of consideration. Surface indications are lacking owing to the extensive river drainage. Bituminous clays and marls have been met in borings and gas pockets in many salt mines. Thermal springs, with small quantities of oil, natural gas, and rich in bromides, iodides, borates, and hydrogen sulphide, constitute indirect indications. The relation of the indications to geology is shown by a map and sections. The indications follow tectonic lines, but do not coincide exactly with anticlinal axes. In Lorraine the Trias is composed of marls, clays, grits, salt, gypsum, anhydrite and lignite, and is better developed than at Gabian. Test wells need be little deeper than 2000 ft. in order to explore the Trias.

R. O. Y.

1406. Comparative Study of the Salt Domes of Hanover and Some Tunisian Structures. A. Roux and M. Solignac. *Ann. des Comb. Liq.*, May–June, 1937 (3), 447–509.—Analogies between the structures of these two areas were perceived and a special study was made of the German deposits and exploitation and prospecting methods during the past year.

The first part of the paper deals with the German structures in considerable detail. A summary of German oil occurrences is given; of these the salt structures of the North German Plain receive individual consideration, the diapiric cores and the beds pierced by the salt stocks receiving particular attention. Nienhagen and Wietze, the two principal fields in this area, receive separate consideration. For Nienhagen the general geology is discussed, with coloured maps and sections, together with the detailed stratigraphy and a discussion of crude oil analyses and producing horizons.

Finally tectonic considerations and the history of prospecting are discussed. The stratigraphy, producing horizons and crude analyses, tectonics and history of research at Wietze receive particular attention.

The statistics, including production figures of individual fields, are discussed for Germany, together with the organization of oil exploitation.

Finally, comparisons are made between the occurrence and morphology of the salt masses in the two areas. In Germany the salt is of Permian age, the salt domes have large dimensions and are ellipsoidal in form and are associated with cap rocks. With the exception of the age, which is as yet uncertain—possibly Triassic—the same is true of the Tunisian occurrences. A further similarity is in the great thicknesses of sediments associated with the flanks (*e.g.* Djebel Ahmar, A. Rhelal, Dj. Sakkak-Lanserine).

In Germany and Texas, unlike Roumania, it is possible to find oil accumulations on the flanks some distance from the core, depending on the distribution of reservoir rocks. The question of the effect of faulting on watering of sands is discussed in the light of German experience. The exploitation of the Tunisian salt domes has every advantage when it begins, for not only is the geology made simpler by the comparative absence of alluvium, but the results of German experience may be used. The paper is illustrated with thirteen admirable coloured maps and sections of the German fields.

R. O. Y.

1407. Search for Oil in Switzerland. G. Vié. *Rev. Petr.*, 17.9.37 (751), 1314.—Oil indications are abundant in the Juras, and van V. v. der Gracht, in 1934, considered them to originate in the Lias or Upper Trias, where mother rocks might be expected. A well is now being drilled at Cuarny, which started in May 1936. A 60-m. derrick and powerful equipment are being used. At present the well has reached the lower Sequanian stage. Many good oil shows and high-pressure gas pockets have been met, but so far reservoir rocks have been absent. According to forecasts, the well should have to go to nearly 2000 m.

Three further wells are to be drilled by the same company, the first commencing October 1937 in the canton of Neuchâtel, where asphalt exploitation has already taken place. R. O. Y.

1408. Rock Asphalt Mining in Switzerland. R. E. Rickard. *Mining Mag.*, 1937, **57**, 73–83.—The asphalt is obtained on the south side of Val de Travers in the canton of Neuchâtel. Although other minor occurrences of asphaltic rock are found in the region, they are poor in quality and limited in extent.

The rock is a bitumen-impregnated limestone, and forms the uppermost bed of the Urgonian (Lower Cretaceous). It is overlain by the Upper Cretaceous, consisting of sandstones and clays and by Tertiary deposits of marl and clay. The bed has an average thickness of 3·50 to 4 m., and outcrops near the right bank of the River Areuse. The position of the deposit is given in a section which shows that the surrounding rocks have been subjected to much lateral pressure, giving rise to synclinal and anticlinal folds. The dip approaches the vertical in certain places, whilst at others it is nearly horizontal.

The bitumen content of the limestone is from 8 to 9·5%, but in some parts of the mine it reaches 12%; the bitumen is of organic origin. Details of the methods of mining are fully described. G. S. S.

Geophysics.

1409. Fundamental Theorem of Applied Geophysics. H. Löwy. *Terrestrial Magnetism*, 1937, **42** (2), 159–162.—The fundamental problem of applied geophysics is to determine whether an analysis of physical measurements made on the earth's surface with the object of finding the depth and extent of mineral deposits can be made in a unique manner. At present this is not so in the case of gravitational, seismic, and magnetic surveys. The author has, however, published a solution for the electrodynamical method. His solution is based on the fact that the electric constants of rocks are determined by their water content, and the method can be used only in arid regions. The n-layers of the resistivity method, if of dry rock, can be regarded as one dielectric layer. If any conducting layers occur within these, only the uppermost need be considered. The problem is thus reduced to a curved conducting surface below a dielectric cover of varying thickness. The various deposits are characterized by different ranges in the values of resistivity and dielectric constants. S. E. C.

1410. Continuous Profiling Method of Seismographing for Oil Structures. S. J. Pirson. *Amer. Inst. Min. and Met. Engineers, Tech. Pub.* No. 833, 1937, p. 9.—A method involving closer spacing of shot points and closer control of the depth points is now being used in Mid-Continent regions. Where possible, shot points are preferably located at intervals of ¼ mile, the distance between detectors being 220 ft. Details are given for the computation and correlation of the seismic records, including the time marking on photographic strips, the estimation of weathering corrections, the reduction to a fiducial plane and elevation corrections. Although the method is rather slow, an average of 2 miles per day can normally be covered in open country. D. W.

1411. Correlation Method of Seismographing for Oil. S. J. Pirson. *Oil Weekly*, 20.9.37, **87** (2), 24–44.—The main sources of error which have to be corrected in correlation seismograph surveys are as follows: velocity gradient over large areas, angularity, anisotropy of the beds, multiple layers in the weathered zone, and elevation. The ground roll must also be eliminated. Each of these points is discussed, and the method of correction is described with the aid of examples.

Correlation depends on the recognition of reflection impulses coming from the same bed, and on the observation of corresponding events on these impulses. This is not an easy matter, and the most likely interpretation can often only be selected from a knowledge of the regional geology. Faults are difficult to infer from seismic reflection records. Rarely they are shown by steep dips, and at times the record is blurred, due to shattering spoiling a good reflecting horizon.

Two methods of depth calculation are outlined. G. D. H.

1412. Seismic Determination of a Reflecting Plane. F. Gassmann. *Beitr. zur angew. Geophysik*, 1937, **7** (1), 17–20.—A series of equations is developed whereby the depth and position in space of a reflecting surface may be determined. The seismic waves are considered to travel from the focus in a homogeneous medium, be reflected at the surface in question, and then be recorded at three seismograph stations.
S. E. C.

1413. Seismic Disturbances Induced by Deep Rotary Drilling. H. F. Wright. *Oil & Gas J.*, 30.9.37, **36** (20), 42.—Vibrations from the drilling rigs has caused considerable trouble in developed town lot areas.

A series of tests have recently been conducted to determine the magnitude of vibrations from this cause and the distance from the source to which they might be traced.

The instrument used in making the tests was the geophone in common use in seismographic work. A newly designed mechanism, which indicates all shocks of whatever magnitude and permits reading the intensity of the induced electric current from the dial of a voltmeter, was substituted for the usual recording apparatus which is tuned to exclude violent shocks.

The shocks to which a given building is subjected are of two kinds: those transmitted through the ground as miniature earthquakes and those transmitted through the air.

There are at least three sources of vibrations at a drilling well: (1) rotating tools grinding upon solid earth or rock, (2) vibrations of surface machinery and pumps, and (3) the pulsation of boilers fired under a heavy load.

A series of charts is given to show the type of intensity of vibrations that may be expected at different depths and under different conditions. L. V. W. C.

1414. Seismic (Refraction) Surveying in Germany. H. Reich. *Beitr. zur angew. Geophysik.*, 1937, **7** (1), 1–16.—Extensive areas in North Hanover and Schleswig-Holstein have been surveyed by the refraction method, using both linear and fan shooting. During this work discrepancies of a systematic nature were noted between depths given by boring and those given by calculation. The case of the Upper Cretaceous is especially considered. It was found that velocities in the same horizon (*Mucronaten* zone) increased from approximately 2000 m./sec. to 4000 m./sec. with increasing depth. In view of this the usual depth curves were not drawn, but depths were plotted against the time taken for a wave to travel 4 km. This relationship was found to be approximately linear in the case of the Upper Cretaceous horizon. However, local variations do occur. There is also evidence that the increase in propagation velocity with increasing depth of the Upper Cretaceous is not continuous, but progresses in sudden jumps. S. E. C.

1415. Use of Astatized Pendulums for Gravity Measurements. G. Ising. *Amer. Inst. Min. and Met. Engineers, Tech. Pub.* No. 828, 1937, p. 14.—Recent technical developments of a highly astatized vertical pendulum, turning about a horizontal elastic axis, render the instrument eminently suited for comparing gravity at widely separated stations. This type of pendulum, preferably suspended with its centre of gravity above the axis of rotation, tends to obviate the disturbing influence of elastic after-working prevalent in all spring-device instruments. An automatic photographic film-recording arrangement has now been incorporated in this Swedish invention. D. W.

1416. Survey of a Salt-Stock by the Thyssen Gravimeter. S. v. Thyssen. *Montan. Rundschau.*, 1937, **29** (15), 6–8.—The Thyssen gravimeter is superior to the torsion balance in areas where there is a strong disturbance of the gravity gradient and curvature. This is illustrated by measurements made with both instruments over a salt-stock near Walsrode (Hanover). Two maps are given contrasting the data obtained with gravimeter and torsion balance. S. E. C.

1417. Phase Measurements in Electrical Prospecting. H. Hedstrom. *Amer. Inst. Min. and Met. Engineers, Tech. Pub.* No. 827, 1937, p. 18.—Describes the apparatus,

field procedure, and interpretative calculations involved in the "Turam" phase measurement method of ore prospecting. Phase difference and amplitude ratio anomalies between alternating electromagnetic fields are recorded at adjacent observation points, the comparison of plotted profiles affording an indication of the ground conductivity. It is claimed that this new method is simpler, cheaper, and more efficient than the older reconnaissance methods, such as the equipotential-line system, which are thus being supplanted in many countries. The Turam work not only locates and outlines conducting ore-bodies, but is also capable of elucidating their structures, even if contiguous beds of extremely conductive graphitic slates be present.
D. W.

1418. Some Graphical Solutions in Torsion Balance Prospecting. V. G. Gabriel. *Beitr. zur angew. Geophysik.*, 1937, **7** (1), 39–48.—A mathematical analysis is made of the effect of an underground body the dimensions of which are infinite in two dimensions. Two diagrams based on this analysis were prepared, a cylindrical co-ordinate system having been used. Results obtained by the use of these diagrams are compared with those given by Lancaster Jones's formula for the same problem, and the maximum difference is of the order of ½%.
S. E. C.

1419. Comparisons of Methods Show Accuracy of Underground Surveys. W. A. Sawdon. *Petr. Eng.*, Oct., 1937, **9** (1), 56.—The comparison of surveys made in the same well by the orienting and magnetic methods and under different conditions, in open hole and in cased hole, has demonstrated the remarkable accuracy that is being obtained in well-conducted underground survey work.

Comparisons of oriented surveys made at different times after the subsurface conditions of the well have been radically changed, and of others made by the use of different media on which the instrument is run in the same hole, have increased the confidence that can be placed in oil well surveying.

Oriented surveys require a trained field crew and the calculations should be carried out under the supervision of an engineer. The magnetic single shot, on the other hand, can be operated by the drilling crew, and the results of the survey are easily calculated.
L. V. W. C.

1420. Bükkszék Oil Occurrences and Prospecting in the Great Hungarian Plain. L. von Lóczy. *Petr. Z.*, 1.10.37, **33** (39), 1–10.—The first Hungarian oilfield will be developed at Bükkszék. The oil occurs in the crestal part of a large, uplifted and considerably faulted structure. The reservoir rock is a fissured andesitic tuff, interbedded in the dense Kiscelle shale. Three productive horizons have so far been found, and a total production of 220 tons was obtained during the period May–June. The Bükkszék crude is a paraffinous type, more similar to that from Boryslaw than that from Egbell and Zistersdorf.

The more important results obtained while prospecting during the years 1913–1922 are summarized. This earlier work was based mainly on the view that the Miocene salt formation is the source rock, and that prospecting should be carried out where this is covered by an adequate thickness of impervious material and where folded structures are found. Work was therefore concentrated mainly on the Great Hungarian Plain, and torsion balance surveys were undertaken to find suitable structures. This was attended by little success. After a discussion on the palæogeography of the area, in which the theory of a Pannonian massif is preferred to the geosynclinal theory, the author passes to prospecting carried out during 1932–1937. Reflection seismic surveys are being made to supplement the gravitational surveys. Numerous new oil shows have been found, and the work points to the importance of the Oligocene deposits and the probability of the Kiscelle shale (Rupelian) being a source rock. The tendency now is to place more importance on block faults (schollen) than on normal folds.
S. E. C.

Drilling.

1421. Recharge Deep Formations to Add to the Ultimate Recovery of Crude Oil. L. G. E. Bignell. *Oil & Gas J.*, 7.10.37, **36** (21), 160.—One of the major drilling problems of the Gulf Coast region is penetrating the heaving shale.

These formations classified as heaving shales have low bearing values, and as the beds lie horizontal or nearly so in their original attitude, the bearing values are higher than when these same beds have been tilted.

It has been concluded that, due to the great weight of the overburden on these uptilted sediments, they have become more or less plastic, and actually flow into the drill-hole and cause trouble when penetrated.

An effort was therefore made to prevent drilling mud from giving up its water to these soft sediments.

Several methods have been recommended, and one tried recently is that of using a mud made of salt-water clay, secured in Florida, and zinc chloride. The weight of this fluid is reduced to about 12 lb. per gal., and the controlled pressure drilling system is applied. This mud does not discharge the water into the shale, but carries the cuttings to the surface in a satisfactory manner. The mud is screened and centrifuged. L. V. W. C.

1422. World's Deepest Wells. Anon. *Rev. Petr.*, 17.9.37, (751), 1315.—The present tendency towards deep wells is discussed, and statistics for their productivity in various countries are given, also the numbers of abandoned and productive deep wells for the last seven years. The average depths of all wells for the past twelve years are given, showing a slight increase lately, although 1933 gave a deeper average depth than 1934–1936. R. O. Y.

1423. Diesel-Powered Drilling Rigs in West Texas. O. Adams. *Petr. Eng.*, Oct., 1937, **9** (1), 39.—Specially-designed diesel drilling rigs have drilled hundreds of wells in the West Texas Permian Basin. Experience and records relating to economy and operation have been accumulated, and it was evident from the first that one special design would be needed to cope with the severe requirements to meet the demand for speed, torque, flexibility and reliability.

The development of a suitable clutch and transmission that will stand up under the diesel drive has made the diesel-powered rig a success.

The size and weight of modern diesel engines have been adjusted to the work, and they possess the ability to throttle, take on heavy loads, and then pick up power and speed with the load from idling start as well as good cold startability.

Flexibility is obtained by the gear ratio in the transmission, and the diesel-driven rig results in the saving of wear on all the equipment and in smooth, uniform operation. L. V. W. C.

1424. Carefully Planned Boiler-Plant Feature of California Portable Drilling Rig. T. P. Sanders. *Oil & Gas J.*, 23.9.37, **36** (19), 53.—Operating advantages have been gained by the use of superheated steam, automatic draught control, steam jets on the boiler stacks and radiant refractory heads on the gas burners in the boilers on a heavy portable drilling rig in use in the El Segundo field. The portability of the rig has not been sacrificed.

The boiler plant consists of three 125-h.p. 300-lb. working-pressure boilers augmented by a portable superheater. Superheated steam at an average temperature of 550° F. and an average pressure of 250 lb. passes through an insulated line to the drilling well.

The operation of the steam-generating plant is entirely automatic. When an intake valve on an engine or pump is opened, the pressure drop on the supply line not only regulates the fuel supply to the boilers, but also regulates the volume of air mixing with the gas, and induces a draught in the boilers by means of steam jets in the boiler stacks. L. V. W. C.

1425. Reducing Rigging-Up Time Through Proper Layout and Utilization of Equipment. M. Tucker. *Oil & Gas J.*, 30.9.37, **36** (20), 40.—Increasing amount of attention is now being given to obtaining over-all economies from proper layout and rigging-up of heavy-duty rotaries.

The five principal requirements in rigging-up heavy-duty rotary drilling outfits are as follows:—

(1) Safety features should be closely observed.

(2) New locations should be laid out in such a way as to receive the maximum benefit and efficiency from all major rig items.

(3) Locations should be laid out so that loss of time in erecting and dismantling is reduced to a minimum.

(4) Arrangement of drilling plants should be such that maximum convenience, economy and accessibility while in operation should be realized.

(5) They should be also arranged so as to result in the greatest preservation of equipment possible. L. V. W. C.

1426. New Drilling Project in France. C. Finaton. *Rev. Petr.*, 22.10.37 (756), 1475–1476.—With the failure of the Haute Savoie test wells the only test well at present drilling in France is at Pézanas, which is about to enter the Jurassic limestone at about 800 m. The "Office National des Combustibles Liquides" has chosen a new location in Herault, near Gornies, where the upper Trias grits and arkoses may provide suitable reservoirs. R. O. Y.

1427. Drilling Patents. H. P. Wickersham and E. Burns. U.S.P. 2,094,690, 5.10.37. Three-string landing-head.

A. J. Penick and K. T. Penick. U.S.P. 2,094,813, 5.10.37. Rotary drilling machine having special grip rollers in a housing so arranged as to actuate a vertical cam into gripping relation with the drill stem upon rotation of the housing.

H. C. Smith. U.S.P. 2,094,855, 5.10.37. Under-reamer.

H. C. Smith and J. T. Phipps. U.S.P. 2,094,856, 5.10.37. Roller-bit.

W. L. Pearce. U.S.P. 2,096,132, 19.10.37. Drilling-bit having a cutter attached to the lower end. The cutter is formed with oppositely-directed blades and longitudinal fins spaced apart on the forward faces of the blades.

E. F. Raymond. U.S.P. 2,096,135, 19.10.37. Rotary jar.

D. G. Hawthorn. U.S.P. 2,096,359, 19.10.37. Air apparatus for subsurface surveying.

G. P. Mizell. U.S.P. 2,096,995, 26.10.37. Depth-recorder for well drill. L. V. W. C.

Production.

1428. Total Recovery Used as a Guide to Establish Type of Production Practice in Smackover. M. Tucker. *Oil & Gas J.*, 28.10.37, **36** (24), 44.—Close studies of percentage recovery and recovery per acre foot in all producing zones are being made in the Smackover field of Southern Arkansas as a guide to employing more effective recovery practices at this stage of reservoir depletion.

A necessary forerunner to such experiments is a detailed geological study of the past reservoir performance.

The Graves sand as the deepest and most productive per acre foot is being given the first consideration.

A knowledge of the per cent. of recovery to original oil sand content will influence the determination of future production practices. A commonly used formula, which is given in the article, enables this calculation to be made with a sufficient degree of accuracy for the entire drive.

A natural water drive has enabled a large portion of the original oil content as indicated by the present estimated percentage recovery from the Graves sand to be obtained. L. V. W. C.

1429. New Radial-Type Deep-Well Pump Used by Skelly in Polo Field of Oklahoma. P. Reed. *Oil & Gas J.*, 21.10.37, **36** (23), 44.—A recently-developed pumping unit of original design which applies a hydraulic ram to operating conventional subsurface sucker-rod equipment has been tested in the Polo field, Oklahoma, by the Skelly Oil Co.

By combining pneumatic counterbalancing with hydraulic lift, a long stroke of 15 ft. at seven strokes per minute is possible without shocks at reversals. This equipment is known as the Hydraulic Pumper.

The device balances the entire weight of the rods, half the weight of the oil lifted and half the friction and acceleration loads. This is done by compressed air which is enclosed in a pressure vessel, and this balancing medium is placed directly over the actuating fluid. A reciprocating pump, radially arranged, supplies the additional energy to lift the other half of the oil load, friction and acceleration. The pump is driven by any form of rotating prime mover.

The operation of the pump is described in detail. L. V. W. C.

1430. Hydraulic and Plunger-Lift Pumping in California. S. A. Wallace. *Petr. Eng.*, Oct., 1937, **9** (1), 93.—Approximately 93% of the producing wells in California are on the pump. Of 13,093 producing wells in this district, 12,207 are pumping.

Hydraulic and plunger-lift pumping only are dealt with in the article.

The hydraulic pumping equipment consists of a pump and engine unit that is lowered into the well and a hydraulic-power unit placed at the surface.

At the bottom of the hole is a double-acting reciprocating plunger pump direct-connected to, and operated by, a fluid engine. The pumping equipment is run in on pressure tubing and seats in a shoe placed at the bottom of the production string. Clean filtered oil forced down the pressure tubing drives the fluid engine which actuates the pump. The hydraulic power unit at the surface supplies under pressure the oil that operates the fluid engine.

The plunger-lift is operated by gas, and the oil is raised to the surface by the plunger. The plunger travels the full length of the tubing and back again to the bottom at each stroke. It does not lift a column of fluid extending the full length of the tubing, but produces oil in short heads.

A string of special smooth bore tubing is necessary.

Extraneous gas has to be introduced in some cases, and it is often necessary to kick-off a well when the plunger-lift is installed. L. V. W. C.

1431. Old Wells Present Problem in Repressuring Project. P. O'Donnell. *Oil & Gas J.*, 7.10.37, **36** (21), 103.—The old and abandoned wells in the middle district, Pennsylvania, are causing numerous problems to operators who employ secondary recovery methods.

With repressuring projects, the irregular and often closely-spaced old wells in only a few instances lend themselves to such projects.

It is an expensive procedure to plug the old wells and to drill regularly-spaced wells nearby, and it is therefore advisable to employ the old holes in the best manner possible.

A more serious problem is that unless these old wells are properly plugged, repressuring programmes may be ruined. Serious by-passing or channelling may result.

The location of wells, whether producers or abandoned holes, is an important consideration in the development of a property by secondary recovery methods.

L. V. W. C.

1432. Repressuring Depleted Sands in Kentucky Fields. C. Albright. *Petr. Eng.*, Oct., 1937, **9** (1), 66.—Adequate records were not kept of the Kentucky fields in the early part of their life, and many difficulties have had to be overcome in initiating repressuring programmes.

Conservation of natural reservoir energy was not attempted, and, as a consequence, the gas is almost completely gone in the majority of the older pools. Rapid depletion has also been assisted by placing vacuum on many of the fields.

Gas has had to be purchased for repressuring owing to the absence of gas in the natural state.

Apathy on the part of adjoining lease owners towards the project has been another obstacle to the application of repressuring.

The volume of gas introduced to each well on these properties is equal to a gas/oil ratio of about 3000 : 1; a greater quantity of gas has a tendency to channel.

L. V. W. C.

1433. Preparation of Flooding Water to Prevent Plugging Sand. W. M. Ryder. *Oil & Gas J.*, 23.9.37, **36** (19), 60.—Production from the Bradford fields is obtained by driving the crude oil from the sand by water. Hence there must be no plugging at the sand face in the pressure wells, or in the sand body itself, due to the water or any materials it may contain.

Many operators do not attempt to treat the water used in the drive, since they know so little about the subject, whilst others often apply all the treatment suggested to be sure.

The various foreign substances which cause trouble in the water flooding, and how they are to be removed or rendered safe, are dealt with in detail.

L. V. W. C.

1434. Data on Behaviour of Water and Oil Passing Through Consolidated Sand. A. B. Morris. *Petr. Eng.*, Oct., 1937, **9** (1), 108.—The author has carried out experiments on the behaviour of water and oil on their passage through loose unconsolidated sand.

The results of these experiments are given and the author concludes that if the initial pressure of a sand property were known and a core were available from which to obtain the characteristics of the sand, the mean effective characteristics of the entire reservoir could be determined for use in production problems instead of merely postulating conditions throughout the reservoir identical with those revealed by examination of individual cores.

L. V. W. C.

1435. Stripper Wells Gaining Second Wind Through Reconditioning. F. B. Taylor. *Oil Weekly*, 8.11.37, **87** (9), 35.—An increase in reconditioning of old shallow stripper properties in the northern Mid-Continent is noticeable, and new shallow drilling is widespread and has accounted for the discovery of new pools.

A factor of importance in the trend is the interest in secondary recovery; water-flood drives and repressuring.

Reconditioning is being done in many instances by firms specializing in this type of work.

Shooting has become more general, and in wells which include drilling into deeper sands the well is treated as a new hole. Shots should be single and in proportion to the sand.

The condition of the sand face controls the success in rejuvenation of old producers by treating with chemical compounds. Deposition of scale and paraffin on the face of the producing horizon retards the entry of crude into the bottom of the hole.

Acid is being used in the reconditioning of wells to remove the scale and in some cases wall scrapers are found beneficial.

L. V. W. C.

1436. Squeeze Cementing Reduces Gas/Oil Ratio. B. Mills. *Oil Weekly*, 8.11.37, **87** (9), 19.—In several fields that normally produce too much gas, cementing through the perforations in the casing or liner has proved effective in reducing gas/oil ratios.

Before attempting a squeeze job in high gas/oil ratio wells, clear water should be applied to the formation to determine the pressure at which the offending strata takes water. The pressure at which the formation takes clear water is the chief governing factor in the selection of the cement and the nature of the mix.

Gas/oil ratios have been reduced effectively in old producing wells by perforating the casing near the gas/oil contact and squeezing cement into the offending formations.

L. V. W. C.

1437. Production Patents. A. J. Penick and K. T. Penick. U.S.P. 2,094,812, 5.10.37. Flow control head.

F. W. Leidecker. U.S.P. 2,094,897, 5.10.37. A paraffin cutter having groups of equidistant axially spaced cutter blades rigidly secured to a rod, the respective blades in one set of alternate groups being in vertical alignment and the respective blades of the other set of alternate groups also being in vertical alignment, but located a sufficient distance around the rod as to have their centre lines fall midway between the centre lines of adjacent blades of the first group.

K. H. Clough. U.S.P. 2,095,056, 5.10.37. An apparatus for determining the volume of oil in a sample of oil sand containing oil.

C. Magee. U.S.P. 2,095,553, 12.10.37. Trap cage for oil well plunger pumps.

J. R. Yancey. U.S.P. 2,095,899, 12.10.37. A bottom-hole choke for well tubing adapted to be lowered into and removed from a well.

W. C. Erwin. U.S.P. 2,096,234, 19.10.37. Pipe swedge.

A. J. Penick and K. T. Penick. U.S.P. 2,096,350, 19.10.37. Well-head connections.

A. H. Neilson. U.S.P. 2,096,625, 19.10.37. Socket for recovering sucker-rods of different sizes.

W. D. Shaffer and G. A. Humason. U.S.P. 2,096,565, 19.10.37. Tubing head.

E. Calloway and E. P. Jones. U.S.P. 2,096,783, 26.10.37. Apparatus for testing the formation in a well having means for creating a vacuum in the chamber of the tool to induce the inflow of liquid and means for trapping this liquid.

W. E. Gilbert and S. B. Sargent. U.S.P. 2,097,150, 26.10.37. A device for recording the power of a reciprocating well pump. L. V. W. C.

Transport and Storage.

1438. Modern Pipe-Line Practice Uses Automatic Sampling. L. G. E. Bignell. *Oil & Gas J.*, 16.9.37, **36** (18), 126.—To eliminate as much as possible manual sampling of fluids in pipe-lines an automatic sampler has been developed.

In general these samplers must be capable of taking from a flowing stream of oil within a pipe a true portion of the fluid passing a given point during a predetermined interval.

The sample as designed by Stanolind Pipe-line Co. consists of a section of ¾ to 1 in. tubing drilled with several holes on the upstream side of the lower end. A valve is placed in the upper end of this tube and this valve is automatically opened and closed by a clock-actuated mechanism at any interval, and is held open to permit a rubber diaphragm to be filled with fluid. This diaphragm is calibrated to hold a known quantity of fluid.

The pressure of the oil flow forces the sample into the diaphragm and exerts sufficient pressure inside to force a small body of water surrounding the diaphragm back to its reservoir. The sample collected is then automatically flowed into a sealed sample can. L. V. W. C.

1439. Cathodic Protection of Pipe-Lines. R. J. Kuhn. *Oil & Gas J.*, 16.9.37, **36** (18), 201.—Cathodic protection of pipe-lines is to-day a widely written and discussed topic. Such protection has been installed on high-pressure gas transmission and distribution mains in New Orleans for nearly 10 years and has been in use on parts of the low-pressure distribution for a number of years.

An extensive programme of steel low-pressure gas network mains is being laid and protected by cathodic protection in the city of New Orleans. These lines are being laid in a wet acid area and with the heavy well-wrapped coating being used the electric current requirements are small. These installations must be extremely well designed if protection is to be adequate and damage is not to be caused to other structures, such as telephone and telegraph cables.

Uncertainty of the wind is the greatest enemy of wind–electric plants, but against this liability the polarization and film formation on the cathodically protected pipes which carry protection over into the light and no-wind periods are an asset. With rectifiers or other equipment where power is available it is possible to design the generating unit to the exact requirements.

One of the largest items of expense is that of the anodic ground plates. Carbon anodes have been used, but with little success, and zinc sheets and rods have also been tried. L. V. W. C.

1440. Modern Methods in Reconditioning Line. M. Tucker. *Oil & Gas J.*, 16.9.37, **36** (18), 90.—A reconditioning campaign of pipe-lines is being carried out by the Standard Oil Co. of Louisiana. The work consists of uncovering, stripping, raising, cleaning, inspecting, welding, patching, half-soling, sleeving, plaster and pit-welding, coating, wrapping, recoating, lowering and back-filling.

Motor-driven pipe-cleaners prepare the pipe for the inspector and marker, who locate pits and other points of weakness for the welder.

Major welds are usually made before the pits are spot-welded. Plaster welds are extensively made where the pits are too close together for separate spot-welding and not sufficiently deep to require half-soling or patching.

Coating and wrapping follow the welding operations, and the pipe is then lowered into the ditch and back-filling carried out. L. V. W. C.

1441. Stove-Pipe Method Important Development in Welding. A. F. Davis. *Oil & Gas J.*, 16.9.37, **36** (18), 119.—The most recent innovation in electric welding of pipe-lines is the "stove-pipe" method of connecting the field joints.

The method requires one centralized crew for lining up the pipe and arc-welding the joints as construction progresses.

The usual procedure is to line up the pipe on skids high enough for the weld to be made entirely round the joint. The joint is tack-welded as the pipe is lined up, following which the joint is finish-welded. L. V. W. C.

1442. Instal Section of Gasoline Line While Under High Pressure. D. L. Hines. *Oil & Gas J.*, 23.9.37, **36** (19), 57.—The necessity to change an overhead crossing to an underground crossing which could not be accomplished simply by lowering the line into a ditch became important, and this problem was overcome in a newly-devised manner.

With the idea of avoiding flushing of the line, a new method was investigated. The method makes it possible to instal a shut-off at any point on a line while it is under pressure.

The essential equipment includes a special fitting which is welded around the pipe, a cutting tool which opens up the line without allowing leakage, an instrument for forcing a rubber plug into the line, and an instrument for capping the opening after the plug has been removed.

The operation is described fully. L. V. W. C.

1443. Wax Plug Used to Clean Line of Interior Accumulations. F. D. Posey. *Oil & Gas J.*, 16.9.37, **36** (18), 95.—Deposition of wax on the inside of lines produces a roughness which causes or increases turbulence and a resulting reduction of flow, as well as materially restricting the area of the cross-section of the oil stream. Scrapers have been used for removing this wax, but inconvenience is caused where the lines are not designed for the insertion or removal of the go-devils, and any ells or sharp turns will impede the passage of such tools.

The General Petroleum Corp. has tried a go-devil of wax taken from another line. The wax was packed into a length of 6 to 8 ft. by ramming with a stout club, inserting occasionally, every foot or so, a circle of cardboard the diameter of the pipe.

The pump forces this plug along the line, causing any deposit in the pipe to accumulate in front of it.

Lines which have fallen below 50% of their normal capacities have been dewaxed in this manner. L. V. W. C.

1444. Determining Point of Water Condensation in Pipe-Lines. A. D. Greene. *Oil & Gas J.*, 16.9.37, **36** (18), 97.—Condensation in gas lines, from fields not equipped with processing plants, provides a constant source of trouble, such as causing pulsation of meters at well-measuring stations, reducing line capacity and increasing the likelihood of the formation of hydrates. If the fluid is not removed from the gathering system as it collects, it will gradually find its way out of the field and into the transmission lines. The installation of a scrubber at the outlet of the field does not prevent further condensation due to temperature drop after passing the scrubber.

The method adopted by the United Gas Public Service Co. to determine the point of water condensation is described in detail. L. V. W. C.

1445. Rotary Engine Drives Cathodic Protection Generator. B. Harrell. *Petr. Eng.* Oct., 1937, **9** (1), 117.—The Houston Pipe-Line Co. has been experimenting with a small cathodic protection unit powered by a rotary engine. A small rotary engine designed to run on air and steam was redesigned to operate on natural gas at the pressure drop available. The engine was direct-connected to a 2·4-kw., 1750-r.p.m. generator rated at 60 amp. and 40 volts.

The engine was machined to 2000ths of an inch clearance between the rotor and the cylinder wall and trued up to where it will drive the generator at maximum rated load. A 2-in. by-pass was run to carry the gas through the machine to drive the generator up to speed. The arrangement of the negative binder post and positive feeder system are shown by means of diagrams. L. V. W. C.

1446. Heat Conductivity of Soil Governs Heat Losses from Heated Oil Lines. C. N. Johnston. *Petr. Eng.*, Oct., 1937, **9** (1), 41.—Heat conductivity of soils being traversed by hot oil lines governs the heat loss from those lines. Heat loss is a factor in pipe-line design, and corrections to existing empirical formulæ are available to take into account the varying heat conductivity of the soil traversed.

The heat loss is influenced by prevailing weather conditions, yet under ideal summer conditions, sections of pipe-line show wide differences in heat loss. The research reported in the article gives the basis for determining in advance of construction, what actually will be the heat loss both in winter and summer over a given location. L. V. W. C.

Gas.

1447. Liquefied Gases Becoming Increasingly Important Products of the Oil Industry. W. T. Ziegenhain. *Oil & Gas J.*, 19.8.37, **36** (14), 22.—Statistics are given of the quantity of propane, butane and mixtures sold as liquefied gases in the U.S. from 1922 to 1936. Of the present production 63% is used as industrial fuel, 9% is absorbed by gas manufacturing utilities and 28% is used domestically. In the automotive industry propane is used for the heat treatment of special steel parts of car engines and running gear, owing to its clear intense and easily controllable heat. Mixing with butane is used in order to adjust flame temperatures. Mixtures of these gases are also used in bench testing of car engines and for cutting scrap and trimming edges of castings and forgings.

Railroad companies used propane as fuel to drive ice engines for air conditioning (the cost being estimated at $1 per 1000 miles travel), in the engine-repair shops for heat treatment of steel parts, for torch cutting, in heaters to keep switches operative in winter, in stoves or dining-cars, heating fruit-houses, shops, stations, and driving gas-electric locomotives for short haul and switching service. Farm tractors, hoisting engines, buses and power generating plants utilize butane as a power source.

Surplus butane removed by stabilizers and not required for blending into winter fuels is used in polymerization units, whilst propane is used for dewaxing. Large quantities of butane and propane are processed for the manufacture of alcohols, anti-freeze compounds, solvents, etc. For domestic purposes gases are supplied in the liquid state or pumped through the mains after mixture with air. C. L. G.

1448. Determining Hydrogen Sulphide Content of Gas in the Field. R. M. Lilly and N. P. Chesnutt. *Oil & Gas J.*, 19.8.37, **36** (14), 52.—A convenient and accurate field method for the determination of H_2S in natural gas consists of absorbing a measured quantity of gas in ceric sulphate solution, the unreduced solution being titrated with ferrous sulphate using an internal oxidation-reduction indicator (an *ortho*-phenanthroline ferrous complex). The ceric sulphate solution is permanently stable, and unaffected by light, air and CO_2, and not liable to side reactions, whilst the indicator is permanently stable and fully reversible, the end-point being a change from a faint blue to an intense red. An indication of approaching saturation of the solution is given by the opalescence due to the suspended free sulphur formed during the reaction.

It has been ascertained that no reaction with heavy mercaptans takes place, although the effect of light mercaptans is unknown. C. L. G.

1449. Patents on Gas. Ruhrchemie A.G. E.P. 471,595, 7.9.37. Production of hydrocarbons by the catalytic conversion of carbon oxides and hydrogen at high temperatures and pressures. The catalysts are added liquid substances applied in such quantities as to enable the mass to be conveyed and introduced into the reaction chamber as a suspension, *e.g.* Kieselguhr and nickel.

F. H. Rogers. E.P. 473,009, 4.10.37. Removal of resinous deposits from combustion gases by electrical treatment.

G. W. Johnson. E.P. 473,501, 14.10.37. Separation of tertiary olefines from gas mixtures by treatment with gaseous hydrogen halides at 50–120° C. in the presence of solid halides of barium or magnesium. W. S. E. C.

Crude Petroleum.

1450. Ceresins from Roumanian Crudes. I. L. Blum and M. Marinescu. *Mon. Petr. Roum.*, 1937, **38**, 1335–1338.—A dark-brown, soft, gummy material is found to collect at the bottom of oil reservoirs, in pipe-lines, and on the sides of wells. Its melting point may be as high as 80° C., so it has been classed as a ceresin, with which its microcrystalline structure agrees.

Supplies of natural ozokerite are running short, and the crude wax can take its place as a source of ceresin; the necessary refining is along the same lines. Distillation in a current of steam separates the organic material from the inorganic. The hydrocarbons in the former are separated from the asphalto-resinous impurities by treating with sulphuric acid and fuller's earth. The refined wax is yellow, very soft and gummy, but its melting point differs only very slightly from that of the original. The softness and viscosity are due to the presence of mineral oil, which can be removed to only a small extent by concentrating *in vacuo*.

The crude waxes vary slightly, according to place of origin, but vary considerably with different conditions of storage (pressure and temperature) of the oil.

The yield of refined wax is 72·68% from well linings, 82·18% from pipe-lines, and 59% from reservoirs.

In comparison of petroleum ceresin, natural ozokerite and paraffin wax, the microscope cannot be relied on, since a small amount of petroleum ceresin produces in paraffin wax the crystalline structure characteristic of ceresin.

The melting point is not of much use in identification, but the molecular weight is of use. The molecular weights are; ozokerite 667, paraffin wax 375, petroleum ceresins 468, 698 and 759, according to origin.

A further differentiation can be obtained by means of the solubility of the three waxes in a chloroform absolute-alcohol mixture; the details of such a test are given. The results from such a test indicate that the petroleum ceresins behave like a mixture of natural ceresin and petroleum wax.

By the use of solvent extraction it is possible to prepare from the crude petroleum ceresins a petroleum jelly and a product very similar to natural ceresin. The highest yield obtained is 60%, from the material deposited in the pipe-lines. In this case the extracted ceresin had a melting point of 79° C. W. E. J. B.

1451. Investigations by the "Societa Petrolifera Italiana." D. A. Greig. *Riv. Ital. Petr.*, Oct., 1937, **5** (54), 6–9.—The chemical and physical characteristics of the crude petroleum of the Italian fields indicate a deep-seated origin with subsequent migration and intense filtration. A type example of filtered crude oil is that of the Salsomaggiore zone, as may be seen from the following table:—

S.P.I. Well No.	Depth (metres).	Density.	Gasoline. 0–150° C.	Kerosine. 150–300° C.
11	158–173	0·7933	50%	35%
54	198–215	0·8115	45%	44%
203	399	0·8181	36%	42%
203	503	0·8230	33%	44%
60	684	0·8356	0%	80%
60	1035	0·8493	1%	74%

There is good reason to believe that the source rock is mainly of Upper Triassic age.

The paper contains an historical account of the search for oil in Italy, including recent developments in the Vallezza zone, where a productive area of 2 square kilometres, with oil at a depth of 800–900 m. has been defined. L. O.

Cracking.

1452. Products from Cracking Gases. R. Fussteig. *Petr. Z.*, 13.10.37, **33** (41), 4.—In the preparation of alcohols from cracking gases active charcoal is used at 40° C. to give a sharp separation between ethylene and its homologues. The latter are removed from the charcoal by steam and led through absorbers containing different strengths of sulphuric acid with 1% AgCl. Butyl and amyl alcohols are thus obtained. J. W. J.

Hydrogenation.

1453. Patents on Hydrogenation. International Hydrogenation Patents Co., Ltd., and I.G. Farbenindustrie A.-G. E.P. 472,354, 22.9.37. Destructive hydrogenation of coal and light oil to produce diesel fuel.

G. W. Johnson. E.P. 472,538, 20.9.37. Destructive hydrogenation of bituminous substances to produce low-boiling aromatic hydrocarbons. The fraction boiling above 250° C. is dehydrogenated, the side-chains are split off by means of haloids or oxidizing agents and the product is cracked in the presence of a small quantity of hydrogen.

H. E. Potts. E.P. 472,691, 29.9.37. Destructive hydrogenation of middle oils to produce anti-knock benzine. W. S. E. C.

Refining and Refinery Plant.

1454. Utilization of Heat in Central Crude Dehydration Plants. R. W. French. *Oil & Gas J.*, 14.10.37, **36** (22), 60.—A description is given of a crude dehydration plant consisting of a direct-fired pipe-still type heater, with complete heat-exchange equipment and control. The unit produces 3800 brl. of clean oil daily from an emulsion containing 50% of water. From the supply tank the emulsion is pumped through a pair of heat exchangers which utilize the heat of the waste-water efflux, and thence to the gun barrel, where some water is lost by the action of heat and chemical injection. Heat exchange then utilizes the heat in the clean oil, followed by the latent heat of the pump exhaust, raising the temperature of the emulsion to 150° F. It is then heated to 177° F. in the pipe-still, heated and passed to four treaters, and thence to two re-run treaters, in which the water is reduced from 1¼% to ¼%. Data on the design of the heater, plant heat balance and heat-exchanger calculations are given.

The plant described showed the following advantages over the live-steam unit previously used: water content reduced from 1·75 to 0·5%, increase in gravity of clean oil, corresponding to an increase in value of $980 per month, installation saving of $5180, fuel economy of 49% and maintenance expense reduction of 5%. Treating cost was lowered by 10%, and cost of plant reconstruction will be returned in 17 months. C. L. G.

1455. Refining with Selective Solvents. F. Spausta. *Brenn.-Chem.*, 1937, **17**, 333–342.—An excellent review of the principles of solvent refining and the practice at different refineries. 104 references.

1456. Columbium Bearing Steel Has Many Favourable Properties. Anon. *Oil & Gas J.*, 14.10.37, **36** (22), 74.—Although the creep strength of 4–6% chromium steels has been improved by alloying with molybdenum or tungsten, their tendency to air-harden causes difficulties in welding, also heating above the critical range during use or installation by welding tends to result in excessive hardness and brittleness on cooling. The reduction in toughness caused by high-temperature treatment is even

more apparent after use at temperatures below 32° F. The addition of columbium, however, eliminates or reduces air-hardening, facilitates fabrication and promotes stability of toughness without loss of creep strength after all heat treatments. It also increases the resistance to oxidation at high temperatures.

Graphs are given of Brinell hardness numbers, Izod impact values and creep strengths of Cr steels containing Mo and/or Cb carried out at room temperatures after drawing for 700 hrs. at temperatures of 450–750° C. C. L. G.

Chemistry and Physics of Petroleum.

1457. Sulphonated Naphthenic Acids. S. v. Pilat and M. Turkiewicz. *Petr. Z.*, 13.10.37, **33** (41), 1.—Naphthenic acids from a petroleum fraction boiling between 200° and 300° C., chlorinated 65% in the α position and treated with Na_2SO_3, give products which are acid to methyl orange and Congo red. J. W. J.

1458. Reactions of Pure Hydrocarbons in the Presence of Aluminium Chloride. G. Egloff, E. Wilson, G. Hulla and P. M. van Arsdell. *Chem. Reviews*, 1937, **20** (3), 345.—This paper presents a comprehensive summary of all the more important reactions of pure hydrocarbons of the paraffin, olefin, acetylene, *cyclo*paraffin, *cyclo*-olefin, terpene, and aromatic series which occur in the presence of aluminium chloride. In the seven groups of hydrocarbons studied in the presence of aluminium chloride under a wide range of experimental conditions, the reactions of dissociation, dehydrogenation, hydrogenation, isomerization, cyclization, polymerization, alkylation, and aromatization play principal rôles, with various exceptions. The striking fact stands out, however, that the key hydrocarbons resulting from many of these reactions are the butanes, and, in particular, *iso*butane.

Of particular interest is the reaction between benzene and 2 : 2 : 4-trimethylpentane in the presence of aluminium chloride; mono- and di-*tert.*-butylbenzenes being obtained, as well as *iso*butane. H. E. T.

1459. Paraffin Hydrocarbons Isolated from Crude Synthetic *iso*Octane (2 : 2 : 4-Trimethylpentane). D. B. Brooks, R. B. Cleaton and F. R. Carter. *Bur. Stand. J. Res.*, 1937, **19** (3), 319–337.—As this material is used as a knock-rating standard, it was necessary to determine not only the amount of each impurity present, but also its knock-rating. Since certified *iso*-octane is about 99% pure, a large amount would have to be processed to obtain the required amount of each impurity. However, the final purification of this material is by distillation, and the manufacturers supplied a quantity of fore-run and still residue from this operation for this work.

Separation was effected by systematic distillation, fractional crystallization by equilibrium melting or crystallization from methane.

As a result, a number of *iso*paraffin hydrocarbons were obtained in a state of relatively high purity. Their physical properties were determined—including freezing points, boiling points, refractive indices and densities, the coefficients of variation of the last two with temperature, coefficient of variation of boiling point with pressure, and A.S.T.M. octane numbers. D. L. S.

1460. Infra-Red Absorption of Nineteen Hydrocarbons, Including Ten of High Molecular Weight. F. W. Rose, Jr. *Bur. Stand. J. Res.*, 1937, **19** (2), 143–161.—The association of the infra-red absorption spectra of hydrocarbons with their structural types was substantiated in a previous report on thirty-five hydrocarbons of low molecular weight (Liddel and Kasper, *Bur. Stand. J. Res.*, 1933, **10**, 599–618).

In order to make the results of greater value in the identification of the constituents of petroleum, data on more compounds of different types were needed, and this paper gives new information in this direction.

The spectrograph employed has been already described.

From the experimental results obtained the molal absorptive index K was calculated, using the following equation:

$$K = \frac{-\log_{10}\frac{I}{I_0}}{cd}$$

where l is the intensity of transmitted light and l_0 that of the incident light, c-conc. in moles/litre and d-cell depth in cms.

K was then plotted against wave-number $\frac{l}{\lambda}$, where λ was the wave-length in cms.

The absorption spectra of nine hydrocarbons of low molecular weight ($C_5 - C_{10}$) and of ten of high molecular weight ($C_{21} - C_{23}$) were recorded over a range of 5400–8900 cm.$^{-1}$ (1·82–1·12 μ) and curves drawn of K against $\frac{l}{\lambda}$. These curves are reproduced in the paper.

It appears that the data obtained can now be correlated quantitatively with respect to the structural units: aromatic, $-CH_3$, $>CH_2$, $\geq CH$ of hydrocarbon molecules.

The results of a mathematical analysis of the near infra-red absorption spectra of fifty-four hydrocarbons follows in a subsequent report. D. L. S.

1461. Fluorescence Efficiencies of Solutions of Hydrocarbons. E. J. Bowen and J. W. Sawtell. *Trans. Faraday Soc.*, 1937, **33** (10), 1425–1429.—It has been shown that a suitable fluorescent screen placed before a photo-cell removes the variation of sensitivity to wave-length of the cell over a particular region, and that this arrangement can be used as a relative quantum counter for the comparison of beams of ultra-violet light.

By this means a potassium photo-cell with uniformity to wave-length within a few per cent. over the range 4400–2450 A. has been constructed.

Two pieces of apparatus have been constructed: (*a*) for measuring the absolute efficiency of fluorescence of a solution of a hydrocarbon such as anthracene, (*b*) for obtaining relative measurements of fluorescence efficiency at very small concentrations.

Purified samples of benzene, naphthalene, anthracene, phenanthrene, triphenylmethane and fluorene in hexane and ethyl alcohol have been examined at various wave-lengths. The results show the low efficiencies of benzene, naphthalene, phenanthrene and triphenylmethane compared with anthracene and fluorene.

It is proposed to continue the work to obtain more accurate values and a source of light giving a more intense emission at 2540 A. will be used. The quenching of fluorescence by added substances will also be studied, and it is hoped will afford some information of the nature of the excited states of hydrocarbon molecules.

D. L. S.

1462. Heat of Combustion and of Formation of the Normal Olefin (Alkene-1) Hydrocarbons in the Gaseous State. F. D. Rossini and J. W. Knowlton. *Bur. Stand. J. Res.*, 1937, **19** (3), 339–345.—In this paper reliable values for the heats of combustion and of formation of all the normal olefin (alkene-1) hydrocarbons in the gaseous state are deduced by using:

1. The generalization that in any organic molecule containing a normal alkyl group of more than 5 C atoms, addition of a CH_2 group to form the next higher normal alkyl group results in an increase in the heat of combustion at 25° C. and a constant total pressure of 1 atmosphere of 157·00 $\pm$ 0·08 kilocalories/mole.
2. The heats of combustion of ethylene and propylene recently measured.
3. The heats of hydrogenation of ethylene, propylene, normal butene-1 and normal heptene-1.
4. The heats of combustion of H_2 and of the gaseous normal paraffins.

Selected best values are given for the heats of combustion at 25° C. and for the heats of formation from solid C and gaseous H_2 at 25° C. and 0° K. of those members of this series of hydrocarbons for which no calorimetric data exist.

As in the case of the previously reported values for the N paraffins and primary N alkyl alcohols, the heats of formation of the gaseous N olefins (alkene-1) can be represented by an expression $\Delta H = A + Bn + \Delta$, where ΔH is the heat of formation, A and B are constant for a given temperature, n is the number of C atoms in the molecule C_nH_{2n}, and Δ is the term giving the deviation from linearity and is zero for $n > 5$. Values of A, B and Δ are given for both 25° C. and 0° K. D. L. S.

1463. Calorimetric Determination of the Heats of Combustion of Ethylene and Propylene. F. D. Rossini and J. W. Knowlton. *Bur. Stand. J. Res.*, 1937, **19** (3), 249–261.—Ethylene and propylene are two hydrocarbon gases which have become very important

within recent years, because of their availability (of the order of 100,000 million cub. ft. annually) as by-products from cracking processes.

Since they are used in the synthesis of alcohols, etc., as well as of synthetic motor fuels, it is important that their thermodynamic properties should be known.

Both gases were subjected to purification treatments to remove traces of contaminating materials, and the combustion process was examined to make certain that no trace of CO was present in the final products.

It was found that the heats evolved in the combustion of gaseous ethylene and propylene in O_2 at 25° C. and a constant pressure of 1 atmosphere to form gaseous CO_2 and liquid water are: ethylene 1410·97 ± 0·30, propylene 2057·42 ± 0·62 international kilojoules/mole. Converted to kilocalories by means of the factor 1/4·1833, these values become respectively, 337·28 ± 0·07 and 491·82 ± 0·15 kilocalories/mole.

A study of the existing data indicates that the hitherto best values for the heats of combustion of these gases differ from these present values by − 1·6% for ethylene and − 0·4% for propylene.

These differences are respectively about 75 and 12 times the estimated uncertainties in these new values. D. L. S.

1464. Pyrolysis of *iso*Butylene at Very Low Conversions. C. D. Hurd and F. H. Blunck. *J.A.C.S.*, 1937, **59**, 1869–1871.—This paper discusses the Schneider and Frolich plan for distinguishing primary and secondary reactions in the thermal decomposition of hydrocarbons, by progressive variation of the rate of flow and extrapolation of the yields of reaction products to zero per cent. conversion. The limitations of this method are discussed, and in the present work *iso*butylene was decomposed at 650° C. to the extent of 0·1 to 1·0%. Under these conditions the only gaseous reaction products were methane, propylene and ethylene.

According to the authors, at conversions below 1% ethylene should practically vanish from the products if the assumptions of the zero conversion method as originally propounded were correct. In actual fact, the ethylene existed in the reaction product to the extent of about 13%, and its persistence even at the 0·1% conversion emphasizes the need for caution in interpreting the initial products of reaction by the zero-extrapolation method. W. E. J. B.

1465. Polymerization of *iso*Prene. W. H. Carmody and M. O. Carmody. *J.A.C.S.*, 1937, **59**, 2073–2074.—This article describes a new experimental procedure which forms a polymer from pure *iso*prene which is completely soluble. The assistance of a mutual solvent for the preparation of a soluble polymer is no longer necessary. The polymerization is effected in the vapour phase, using aluminium chloride, and yields 98% of soluble polymer with a molecular weight in benzene of 1300. This is about double the molecular weight of the soluble polymer obtained in the usual liquid phase polymerization. The apparatus required is very simple. W. E. J. B.

1466. Normal Boiling Point and Critical Constants of Normal Heptane. J. A. Beattie and W. C. Kay. *J.A.C.S.*, 1937, **59**, 1586–1587.—The authors have found the boiling point of *n*-heptane to be 98·52 ± 0·01° C. (Int.) at 760 mm. pressure. The critical constants of *n*-heptane are:

t_c = 267·01 ± 0·02° C. (Int.).
p_c = 27·00 ± 0·02 normal atmosphere.
v_c = 0·416 litres per mole (4·15 c.c. per gram).
d_c = 2·40 moles per litre (0·241 gram per c.c.).

The uncertainty in the critical volume and density is estimated to be 1%. W. E. J. B.

1467. Compressibilities of Liquid and Gaseous Normal Heptane and an Equation of State for Gaseous Normal Heptane. L. B. Smith, J. A. Beattie and W. C. Kay. *J.A.C.S.*, 1937, **59**, 1587–1589.—The authors report measurements on the compressibility of liquid *n*-heptane over a temperature range from 30° to 250° C. and to 350

atmospheres, and on the compressibility of the gas phase from 275° to 350° C., and from a density of 1 to 5 moles per litre.

The data indicated that *n*-heptane, when confined by mercury in a glass vessel, decomposed very slowly at 325° C., but at an appreciable rate at 350° C.

The actual measurements at various temperatures are given in tables, and for densities less than the critical density the constants of the Beattie–Bridgeman equation have been calculated for gaseous *n*-heptane.

Reasonably good agreement is obtained when the calculated pressures are compared with the observed pressures. The paper should be consulted for the actual data.

W. E. J. B.

1468. Compressibility of and an Equation of State for Gaseous Propane. J. A. Beattie, W. C. Kay and J. Kaminsky. *J.A.C.S.*, 1937, **59**, 1589–1590.—Measurements are reported on the compressibility of gaseous propane over a temperature range 96·81–275° C., and from a density of 1–10 moles per litre.

The values of the constants of an equation of state have been determined from the data for densities less than the critical.

The critical constants of propane are given as

$t_c = 96{\cdot}81 \pm 0{\cdot}01°$ C. (Int.),
$p_c = 42{\cdot}01 \pm 0{\cdot}02$ normal atmospheres,
$v_c = 4{\cdot}43$ c.c. per gram,

with an uncertainty in v_c of 1%.

W. E. J. B.

1469. Kinetics of the Explosive Reaction between Hydrogen and Oxygen Sensitized by Nitrogen Peroxide. G. von Elbe and B. Lewis. *J.A.C.S.*, 1937, **59**, 2022–2025.—The nitrogen peroxide-sensitized explosion of hydrogen and oxygen has been subjected to kinetic analysis. The evidence rules out a mechanism based on oxygen atoms, and points to a mechanism in which NO_2, H, OH and HO_2 take part.

Equations are developed for the lower and upper critical concentrations of nitrogen peroxide which satisfactorily account for the known experimental facts.

W. E. J. B.

1470. Kinetics of the Dry and Water-Catalyzed Reaction between Carbon Monoxide and Oxygen at and above the Upper Explosion Limit. G. von Elbe and B. Lewis. *J.A.C.S.*, 1937, **59**, 2025–2028.—A chain mechanism based on material chain carriers has been proposed which explains the experimental facts of the dry and water-catalyzed reaction between carbon monoxide and oxygen at and above the upper explosion limit. The mechanism of the upper limit involves oxygen atoms and ozone as chain carriers.

The mechanism of the reaction above the upper limit includes the mechanism of the upper limit, and in addition a chain initiating mechanism that involves water.

W. E. J. B.

1471. Vapour-phase Fluorination of Ethane. J. D. Kalfee and L. A. Bigelow. *J.A.C.S.*, 1937, **59**, 2072–2073.—The authors describe an experiment wherein ethane and fluorine were allowed to mingle within the meshes of a copper gauze coil, when a perfectly quiet, continuous reaction occurred.

From the gaseous products hexafluoroethane was found in good yield, together with carbon tetrafluoride, and a smaller amount of a product, which was probably methylfluoroform.

From this result it appears to be established that simple aliphatic hydrocarbons containing more than one carbon atom can be fluorinated direct in the vapour phase, with the formation of chemical individuals of known constitution, other than carbon tetrafluoride.

W. E. J. B.

1472. Heat Transmission in Film Type Coolers. A. K. G. Thomson. *J.S.C.I.*, 1937, **56**, 380T–384T.—The film type of cooler is finding extensive application in industry, but data applicable to its design are very limited. Variable factors affect this type

of condenser. The paper is an account of an investigation to determine heat transfer coefficients and their relation to these variables.

Increasing temperature while maintaining a constant water flow had no effect on the rate of heat transfer. Within limits, the thicker the film of water on the tube, the higher the rate of heat transfer, but if the rate of heat transfer is to be increased beyond a certain limit, the water supply must be enormously increased, and the condenser ceases to be a film condenser. In order to obtain higher values for the heat-transfer coefficient without undue rise in cooling water rate, it is necessary to promote disturbance of the water film, either by evaporation of the film itself or by forced air circulation. This latter problem is to be the basis of a further investigation by the author. T. C. G. T.

1473. Automatic Compensation of Flowmeters for Pressure Variations. R. K. Taylor. *J.A.C.S.*, 1937, **59**, 1605.—This paper describes an apparatus for the maintenance of a constant delivery rate through a flowmeter irrespective of pressure variations at the flowmeter outlet.

The apparatus is simple, and can be arranged to accommodate a number of flowmeters. W. E. J. B.

Analysis and Testing.

1474. Determination of Acid Values of Oils by Potentiometric Titration Using the Glass Electrode. A. C. Rolfe and G. P. Alcock. *J.S.C.I.*, 1937, **56**, 294T–298T.—Determination of acid values of oils by colorimetric titration is often difficult, and different operators may obtain different results. The potentiometric method using the glass electrode with quinhydrone and an agar–potassium chloride bridge is capable of giving accurate results. The oil is boiled with alcohol and the acidity determined on the mixture. The method was tested against alcoholic solutions of organic acids. Certain possible sources of error arise, *e.g.*, contamination of the electrode, absorption of CO_2, and incomplete extraction of the acid from the oil, but none of these errors is significant if normal precautions are taken. Dissolution of the oil in a benzene/alcohol mixture was unsatisfactory, and back titration with hydrochloric acid after the addition of an excess of alkali was also unsound. The potentiometric method generally is too slow for routine work. C. C.

1475. Measurements of Certain Physico-chemical Constants of Benzene. M. Wojciechowski. *Bur. Stand. J. Res.*, 1937, **19** (3), 347–352.—Benzene is a very important substance and may prove suitable as a standard for some physico-chemical measurements, *e.g.* for adjustment of refractometers.

There have been certain discrepancies in results already published on the constants of benzene due mainly in the author's opinion to lack of efficient purification.

In this case the benzene was purified by three distinct methods: (*a*) fractional distillation, (*b*) azeotropic distillation with ethanol, (*c*) crystallization followed by centrifuging. Physico-chemical measurements were made on fractions prepared by each of these three methods. The following constants were measured: boiling point 80·094 ± 0·002° C. (by the comparative method of Swietoslawski); freezing point 5·51 ± 0·01° C. (method of B. J. Mair); refractive index n_D^{25}, 1·49807 ± 0·00006 (by specially calibrated refractometer of the Abbe type); density at 25° C. 0·87366 gms./cm.^{3} ± 0·00002 (by comparative method using twin silica pycnometers).

Previous determinations of these constants, as reported in the literature, are reviewed. D. L. S.

1476. Some Notes on the Determination of Minute Quantities of Lead. P. G. Jackson. *J.S.C.I.*, 1937, **56**, 211T–213T.—The accuracy of the colorimetric determination of lead as sulphide has been the subject of conflicting opinions. The author reports his observations on the determination of quantities in the order of 0·1 mgrm. of lead. It is concluded that acetic acid solution with a strength of 2 mls. of 33% acid in 50 mls. of solution is preferable to ammoniacal solution; that, as traces of iron or copper reduced the depth of colour, these metals, and probably any others, should be removed before making a determination; that potassium cyanide does not counteract the effect

of copper and, in ammoniacal solution, reduces the colour; that the hydrogen sulphide water should be fresh and saturated.

Gelatin–acetic acid gave less colour than acetic acid alone. The order of introduction of the reagent should be standardized apparently in the following order—lead solution, acetic acid, water, and then sulphide.

Certain experiments on the precipitation of lead as sulphate are described and the results tabulated. From these, it is apparent that for this precipitation the volume of solution must be kept exceedingly low, *i.e.* for about 0·1 mgrm. of lead, 0·25 ml. of concentrated sulphuric acid, 2·5 mls. of water, and 1·25 mls. of alcohol should be employed. T. C. G. T.

Motor Fuels.

1477. High Octane Petrols. M. Nitescu. *Mon. Pet. Roum.*, 1937, **38**, 1417–1418.—Petrol with a high octane number is wanted for aeroplanes. A few years ago the octane number was placed at 72, but to-day an octane number as high as 92 is required. Experiments with a "Pegasus" motor by the Bristol Aeroplane Co. show a saving of 30% in consumption and an increase of 27% in power by substituting a petrol of octane number 100 for one of 73.

The "Sarmiza" patent for the manufacture of high-octane petrol describes a simple thermal process of polymerization. Kerosine or a mixture of this and gas oil is evaporated in a pipe still at 350° C. The resulting vapour is heated in a second phase to 450° C. and then passed into a third furnace, where heating is carried to a temperature of 640 to 740°. The vapours are maintained for a time at a certain temperature (not given), and then pass into the condensers. The product of this polymerization process is then distilled in the ordinary way. Thus from a kerosine of density 0·802 containing 60% paraffins and 35% naphthenes a polymer was obtained of density 0·904–0·915 containing 74% aromatic hydrocarbons, and from this was distilled a petrol of density 0·8 containing 80–85% aromatics, 47% of which distilled below 100° C., 72% below 120 and 87% below 140° C., octane No. 92, R.V.P. 3·5–4·3 lbs. D″ at 100° F. The volume equalled 75% of that of the kerosine. The residue of toluene after distillation will be useful for making dyes, explosives, etc.

Alloys capable of standing up to the temperature required and resisting corrosion are easily available. No high pressures or catalytic agents are required. The process is claimed to be superior to the cracking of oils, the hydrogenation of coal products, or the manufacture of petrol from natural gas so far as the quality of the petrol and its octane number are concerned. W. E. J. B.

1478. Patents on Motor Spirit. G. W. Johnson. E.P. 471,482, 2.9.37. Production of low-boiling hydrocarbons from gases resulting from the dry distillation of fuels. The gases together with liquid hydrocarbons are passed over a catalyst, *e.g.* H_2SO_4 and H_3PO_4, and the hydrocarbons removed. W. S. E. C.

Lubricants and Lubrication.

1479. Crankcase Oil Temperature Control. E. W. Templin. *J.S.A.E.*, 1937, **41** (2), 325–342.—Since the oil which has constant viscosity at all temperatures does not exist, the next best thing is to control the crankcase oil temperature. It is considered that this should not exceed a figure of 210° F. Cooling water temperatures should not exceed 170° F., and this figure should be reached within two minutes of starting.

A uniform viscosity of 60 Saybolt Universal Seconds is thought desirable, and, if this were practicable, an oil in the SAE. 30 class could be used all the year round for all vehicles, instead of the whole range of SAE. 20 to SAE. 70 at present needed.

Figures for rates of flow of an SAE. 60 oil at various temperatures are quoted to illustrate the need for control. Thus at a pressure of 40 lbs. per square inch the rate of flow through a tube of 0·311 in. internal diameter varies from 0·6 fluid ozs. per minute at 0° F., to 28,900 gallons per minute at 270° F., figures actually experienced in the author's operations.

Some devices for controlling oil temperatures are considered. These include an electric immersion heater in the cooling-water system, temporary dilution with gasoline

at starting, etc. For bringing the oil to running temperature as quickly as possible water-cooled oil-coolers are considered the most hopeful. One such device making use of the car-radiator cooling system is described and results are quoted. Another device is a combined oil-filter and oil-temperature regulator.

After passing through the filter the oil passes through a coil surrounded by a water-jacket, through which flows the engine cooling-water. Such a device economizes in space, is efficient, it is claimed, and, with a by-pass system, safe from the point of view of oil supply and freedom from possibility of water leakage. J. L. T.

1480. Experiments on Sleeve-bearing Lubrication. H. W. Swift and H. L. Haslegrave. *Engineering*, 1937, **144** (3740), 325.—The work described in this paper forms part of a comprehensive investigation of the characteristics and working conditions of journal bearings of the sleeve type under various steady loads and speeds, with different directions of loading, and different ratios of axial width to diameter. The experiment data sought include measurements of shaft attitude and eccentricity, journal and bearing friction, and pressure distribution. The present paper consists essentially of a description of the apparatus constructed for this work and an investigation of its suitability.

The test journal consisted of a nickel-chrome steel brush, formed on a hollow shaft, and operated in roller bearings. The test bearing was of Nitralloy steel, and was loaded upwards on to the journal by a system of levers. The frictional moment on the journal was determined by means of the driving motor, which was mounted for torque reaction measurements. Journal displacements were measured by micrometer screws at both ends of the bearing, electric means being used to detect contact. Oil-pressure measurements were made at thirty-two representative points by means of Bourdon-type pressure gauges.

Some results obtained with the apparatus using a 90° entry angle are in general conformity with theoretical expectations, and such discrepancies as have been found appear to be attributable to vibration at light loads and uncertainty in assessing the temperature of the oil in the pressure bearing film. J. G. W.

1481. Patents on Lubricating Oil. Continental Oil Co. E.P. 471,593, 6.9.37. Improvement of lubricating oils by adding methyl oleate and 0·1–6% by wt. of sulphur.

G. W. Johnson. E.P. 472,553, 27.9.37. Polymerization of olefines in the presence of aluminium chloride and carbon tetrachloride as solvent for the production of lubricating oil.

Edeleanu Gesellschaft m.b.H. E.P. 472,898, 27.9.37. Production of polymerization, oxidation or chlorination products of hydrocarbons by treating mineral oil in the vapour phase with chromyl chloride in the presence of CO_2, N_2 or air.

Brit. Thomson-Houston Co., Ltd. E.P. 473,441–473,442, 13.10.37. Insulating material consisting of a chlorinated diphenyl and up to 10% of a benzyl cyanide derivative.

Standard Oil Development Co. E.P. 473,502, 14.10.37. Lubricating composition consisting of a mineral lubricating oil having dissolved therein a polymer obtained by polymerizing rapeseed oil to which <0·5% elementary sulphur has been added.

W. S. E. C.

Asphalt and Bitumen.

1482. Use of German Natural Asphalt in Mastic Asphalt. O. Martin. *Asphalt u. Teer*, 1937, **37** (30), 401.—An account is given of the use of mastic asphalt in Germany. A. O.

1483. Method for Recovery of Bitumen from Road Materials. H. Suida and H. Hoffman. *Asphalt u. Teer*, 1937, **37** (37), 501–504.—Following a discussion of previous methods and solvents put forward for recovery of bitumen from road materials, a method is described which consists in extracting 1–2 kgm. of the road material, contained in a "filter sack," with 200–300 mls. of benzene in an atmosphere of carbon dioxide in an autoclave, the latter being heated to 120° C. After cooling, the solution is centrifuged and transferred to a distillation apparatus, and the solvent distilled off

in vacuo while passing a current of carbon dioxide. Benzene is considered to be as good a solvent for bitumen, under these conditions, as carbon bisulphide or chloroform, and less objectionable to use. A comparison of penetration and softening-point figures for a series of bitumens of various types before recovery, after recovery from benzene solution, after recovery from benzene solution allowed to stand in an atmosphere of carbon dioxide for 48 hours, and after recovery from benzene solution treatment in the autoclave, indicates that the recovered bitumen is not appreciably altered when the penetration of the original bitumen is less than 250. Further results are given for these bitumens after extraction in the autoclave from a fine asphalt/concrete mixture prepared in the laboratory with the aggregate at 120° C. and the bitumen at 110° C., and also show no appreciable change in penetration or softening point.

A. O.

1484. Bitumen Emulsions for Surface Dressing. Anon. *Asphalt u. Teer*, 1937, **37** (35), 475.—The most suitable types of emulsion for various methods of road surface construction are described, together with details of methods of construction.

A. O.

1485. Patents on Asphalt. C. Russell de Berry. E.P. 471,646, 8.9.37. Asphalt grout consisting of 15% blown bitumen and 75% of a mineral filler.

C. Russell de Berry. E.P. 471,650, 8.9.37. Bituminous emulsion for use in road-making consisting of 60% bitumen, water and a small proportion of a stabilizer and, if desired, a wetting agent.

C. Russell de Berry. E.P. 471,651, 8.9.37. Production of road material consisting of a mixture of 75–87·5% of blown bitumen with a volatile solvent, *e.g.* kerosine, creosote or tar oil—and having a consistency such that it will just pour when cold.

W. S. E. C.

Detonation and Engines.

1486. Some Experiments on Combustion in Oil Engines. E. Glaister. *Engineering*, 6.8.37, **144** (3734), 139–140; 20.8.37, **144** (3736), 195–197.—Tests were made to correlate the delay angle of a fuel and its H.U.C.R. determined in an E. 35 Ricardo engine; and investigation made into the effect of operating conditions and fuel-ignition quality upon the combustion characteristics of a 10-H.P. McLaren–Benz antechamber engine.

A range of test mixtures varying in H.U.C.R. from 4·22 to 6·28 was obtained by adding to a standardized 70 : 30 mixture of light diesel oil and commercial petrol increasing volumes of heavy naphtha and motor benzol, respectively. The delay angle of each blend at different relative compression pressures was determined by throttling the air intake. Relations were thereby established between the delay angle at a selected relative compression pressure and the H.U.C.R., also between the concentration of naphtha or benzol and the delay angle and H.U.C.R.

The effect of jacket temperature was examined using a 50 : 50 diesel oil–naphtha mixture giving a relatively long delay. Measurement of the uncontrolled pressure rise and the peak pressure showed that the temperature factor operates independently on the delay period and on the rapidity of the following active combustion.

In order to examine the relation between the delay period and the uncontrolled combustion phase over a wider range than that obtainable by temperature, the ignition quality of the fuel was varied by adding amyl nitrite to the same diesel oil–naphtha mixture in proportions up to 20% by volume. It is suggested that the form of the uncontrolled pressure rise as defined by its slope and pressure ratio (*i.e.* maximum pressure over compression pressure) affords a more sensitive index to ignition quality than the delay measurement.

The conclusions reached were:

(1) When the ignition quality of the same fuel is varied by naphthenic and aromatic additions, respectively, good correlation is found to exist between the delay period and the H.U.C.R.; this is the same for both groups of mixtures.

(2) The effect of variation in jacket temperature on the delay period and the un-

controlled pressure rise is appreciable, indicating the necessity for constant-temperature conditions when comparing the delay periods of different fuels, and the beneficial effect of a high jacket temperature on the smoothness of running.

(3) The effect of ignition quality on the delay and uncontrolled pressure rise can be examined by adding amyl nitrite as an ignition accelerator. It is found that when the slope and magnitude of the pressure rise are plotted against delay, the same correlation holds, whether the delay is varied by the ignition quality or jacket temperature, showing the delay and uncontrolled combustion to be equally affected by any factor which accelerates combustion.

(4) The slope and magnitude of the uncontrolled pressure rise are very nearly proportional over a wide range of ignition quality. E. F. C.

1487. Fixed Ignition Lag Method of Testing Diesel Units. J. S. Chandler. *Oil & Gas J.*, 2.9.37, **36** (16), 53.—The ignition quality of diesel fuels is of great importance in engine operation, but there is no satisfactory and accurate method of determining this property of fuels. Indices deduced from physical and chemical properties are good only for rough comparative purposes, and are not expected to replace engine tests. The limitations of the following engine test methods are described: Critical compression ratio method, audible knock and vibration criteria, maximum rate of pressure rise, and delay method. The all-electric ignition-lag apparatus devised by T. B. Hetzel in 1935 has been used to develop a method known as the fixed ignition lag method. Injection is adjusted by means of the timing device on the pump to 18° before top centre, then the point of ignition is made to occur at top centre by adjusting the compression ratio. Thus a fixed lag of 18° is used. The required compression ratio (R.C.R.) for each fuel is compared with that of secondary reference fuels, and a rating thus obtained.

The convenience and accuracy have been greatly increased by recent improvements in instrumentation, which are described.

The operation conditions for the method as applied to the C.F.R. diesel fuel testing unit are: (1) Engine speed 900 $\pm$ 30 r.p.m.; (2) jacket temperature—boiling point of water constant within $\pm$ 1° F.; (3) nozzle pocket water exit 100 $\pm$ 1° F.; (4) inlet air temperature 150 $\pm$ 0·5° F.; (5) inlet air pressure 28 $\pm$ 0·01 in. Hg; (6) lubricating oil temperature 150 $\pm$ 10° F.; (7) injection advance 18° B.T.C.; (8) ignition at T.C. exactly; (9) nozzle opening pressure 1300 $\pm$ 100 lbs./sq. in. (with Bosch Nozzle DN. 3083 and a $\frac{1}{16} \times 25$ in. tube); (10) fuel quantity 0·030 mls./injection $\pm$ 10%; (11) rheostat settings to give earliest indication. Procedure to attain equilibrium temperature conditions is specified. The injection timing and compression ratio are then adjusted to make the flashes line up opposite the pointer. The scale reading of the C.R. is increased until ignition takes place several degrees before T.C., and again decreased until ignition is indicated at T.C. This is repeated giving two determinations with increasing and two with decreasing C.R. The average is used to determine the required compression ratio (R.C.R.) for that fuel. This is calculated from the formula R.C.R. $= 1 + \frac{18}{H}$, where H = average of the four micrometer readings of the adjustable plug. Every time when switching from one fuel to another the pump suction is flushed for 5 seconds, then, while the injection tube and nozzle are being purged of the fuel previously used, the other tank is drained, flushed and filled with the next fuel for test.

After testing a series of blends of the two reference fuels, the volumetric percentage of the high cetane fuel is plotted against the corresponding R.C.R. values. The cetane value of the sample is then determined from its R.C.R. The method has been found to give accurate and reproducible results.

In order to ascertain whether the method as applied to the C.F.R. engine gives an indication of the performance of the fuel in other engines, it is proposed to rate a representative group of fuels by the ignition lag method in a large variety of commercial engines and observe the correlation. R. A. E.

1488. Aircraft Engines. A. N. Troshkin. *Engineer*, 1937, **144** (4263), 347.—The author indicates some of the factors contributing towards improved aircraft-engine performance.

Reduction of the specific weight by use of higher-octane fuels is one of the most important. The use of 100 octane instead of 87 octane fuel enables a power increase of over 30% to be obtained for only a small increase in the designed weight of the engine necessitated by the higher power. Fuel consumptions of 0·34 lb. per horse-power hour can be obtained in the cruising range with 100 octane fuel, representing a saving of about 20% over the best 92 octane fuel economy.

A new method of obtaining this high-octane fuel employs a blend of aniline and alcohol called "anilol" as an antiknock compound, which is injected into the carburettor so as to give the desired octane rating to the fuel used. Alternatively, the injector valve and throttle can be interlinked to give an automatic increase in octane rating with increased power. The compound has been found equally effective with leaded or non-leaded fuels.

Various types of automatic power and mixture controls have been developed, and in conjunction with improved instrumentation have considerably relieved the work of the pilot and secured more economic performance of the engine. These factors have assisted also in prolonging the time between overhauls.

Carburettor de-icing has been successfully overcome by injecting alcohol at the venturi or by using alcohol-blended fuels, notably Callis alcohol-blended fuel. This contains, besides alcohol and gasoline, a stabilizing agent to increase the water tolerance of the mixture. The Chandler–Groves non-icing carburettor, however, claims among other useful features completely to eliminate any icing difficulty without recourse to blended fuels or air-intake heat.

Torsional vibrations existing in the radial engine can be reduced to a minimum by use of the Wright Aeronautical Corporation's dynamic damper which employs a pendulum mounting of one crankshaft counterweight instead of the conventional rigid mounting. This pendulum action is accomplished by mounting a counterweight having the mass necessary to balance the engine, so that it can vibrate through a small angle when disturbed.

Materials in engine construction have played an important part in improving the all-round performance of present-day engines, notably in the increased application of magnesium alloy forgings and castings in low-stress sections. Stellite-faced valves working against a seat of silicon–chrome–tungsten provide a combination practically immune to pitting or corrosion and highly resistant to valve-pounding, while nitriding steel cylinder barrels to about 1000 Brinell by means of ammonia gas at high temperature has materially increased their life.

Future developments are anticipated to be in the directions indicated, and high-speed geared engines are suggested as another method of increasing the specific power. Engine noise may, however, become more important, and increases in the power and number of machines necessitate the use of engine mufflers. Work is being carried out in this respect. E. F. C.

1489. Design of Elastically-Supported Foundations for Reciprocating Engines. K. Klopstock. D.E.U.A. paper S. 139, 21.10.37.—The oscillating foundation is suggested as a means of preventing the transmission of perceptible disturbances to the engine installation site and its surroundings.

Consideration of the mass forces operating in an engine and its reaction shows how with a solid foundation the subsoil reacts against the tendency of movement of the total engine system, including foundation. With the freely-swinging system it is shown how, for a given mass force and permissible oscillation amplitude, the value of the required total foundation mass can be calculated. This is shown to be independent of the revolutions of the engine and the exciter frequencies. Diagrams are reproduced to enable the value of the required total foundation mass to be obtained for a permissible oscillation amplitude, or, conversely, the oscillation amplitude of a particular dynamic combination to be read off.

The suspension of the foundation weight on the subsoil is next considered. Results of mathematical investigations into the behaviour of a swinging system excited by masses are given in further diagrams, and it is shown how nearly, with a spring suspension, the ideal conditions of the freely-swinging arrangement can be realized. If, for instance, the lowest value of the exciter frequency is five times that of the elastically-supported system, the swing amplitude of the latter differs only by 4% from that of the freely-swinging system, and the remaining force transmitted to the subsoil amounts to only

about 4% of the largest exciter force of the installed engine. It is found that reduction of the disturbing forces is possible only if the foundation critical is less than the exciter frequency of the engine.

The required foundation frequency is obtained by using a suitable spring element such as cork or rubber or steel springs. Comparison of their elastic properties with those of the alternative materials shows the superiority of steel springs, which permit almost every foundation frequency to be obtained. Cork plates are generally useful only for the reduction of noise oscillations and for mechanical vibrations, or for exciter frequencies over approximately 1500 per minute. Owing to its limited deformation properties, a rubber elastic element does not conveniently permit of foundation frequencies lower than about 170 cycles per minute.

In conclusion, the author quotes and illustrates several examples of actual engine installations showing the advantages and possibilities of the oscillating foundation.

E. F. C.

Coal and Shale.

1490. New Fields for Gas Industry. Anon. *Fuel Economist*, 1937, **12** (144), 433–434, and 448.—The article is a report of a lecture by Dr. J. G. King. A summary states that the lecture dealt with research and development of the use of coal in water-gas plants, also hydrocarbon synthesis, and reviewed the potential fields for high-pressure gas for motor transport, coke developments, and the need for co-operation between the coal and gas industries in order to utilize the special properties of various coals. These points are not expanded in the article, but cannel and tar hydrogenation are given some attention.

It is estimated that there is in Scotland 25 million tons of cannel, and that it can be carbonized in vertical gas retorts with a satisfactory gas yield and 40 to 50 gallons per ton of tar amenable to vapour-phase hydrogenation.

The only recent development in tar treatment of real importance to the gas industry is that of hydrogenation-cracking, the products of which are satisfactory, but the cost of which is prohibitive except on large scales. A central plant is suggested as an alternative to this high production cost.

Hydrogenation of low-temperature tar and of creosote is reviewed, and the yields and qualities of the products are tabulated. A preliminary liquid phase treatment is to be recommended in the hydrogenation of low-temperature tar. Yields from the hydrogenation of high-temperature tar are also tabulated. In the hydrogenation of low-temperature products one treatment of tar yields 55% spirit and 53% oil, whilst the respective figures for creosote treatment are 72% and 41%. The complete conversion of tar to spirit yields 101%, whilst from creosote there is a 106% yield. The properties of the spirit are similar in each case; specific gravity at 15° C. being 0·810–0·830, 17–18% distilling below 100° C., aromatics 25–29%, unsaturateds 1–2%, octane number 70, the higher figure in each case being for spirit from creosote. Hydrogenation of high-temperature tar, in liquid phase, yielded up to 86·9% of oil containing 65·3% boiling below 300° C., 20·2% of which was spirit. The 21·6% of oil boiling over 360° C. was recycled until the boiling range was below 300° C., when, together with the other oil, it was transferred to vapour-phase hydrogenation to yield 100% spirit.

Deterioration rates of catalysts are rather high.

T. C. G. T.

1491. Production of Shaped Coke. D. Brownlie. *Fuel Economist*, 1937, **12** (144), 417–418 and 420.—This article is an account of the latest developments of low-temperature carbonization processes in Germany. Since 1932 there has been a revival in this field, due apparently to the fact that low-temperature tar is better suited to hydrogenation than solid fuel. The newly developed processes, such as the "Brennstoff-Technik," "Berg," "Hinselmann," "Krupp-Lurgi" and "Otto," all produce a smokeless fuel in small, hard, uniform pieces—"shaped coke"—particularly intended for producer gas vehicles.

The Brennstoff-Technik retorts are of the vertical intermittent, externally heated type, with carbonization at 600° C. and 4–6 hrs. heating. This retort may be constructed with or without collapsible walls. Two of these plants are operating in Germany, one with a daily throughput of 10 tons and the other of 24 tons.

The Berg process is of particular interest, as two such plants are in course of erection in Cumberland; also it is in growing favour in Germany—in fact, a plant is to be erected to handle 350 tons of coal per day. The process charges coal in cages of trays, carbonizes at a temperature of 450–500° C. in the charge, and the coke is moulded in the bottomless trays. A typical yield per ton of bituminous coal is 2500–8850 cu. ft. of gas, 7–10% of tar oil, and 70–75% of smokeless fuel.

The Hinselmann process is essentially a tunnel oven in which bituminous coal is carbonized under low-temperature conditions in a series of travelling cast-iron bottomless trays. These trays travel through a gradually rising temperature, reaching a maximum of 500–600° C. T. C. G. T.

Economics and Statistics.

1492. Report of the Argentine Government Oilfields for 1936. R. Silveyra. *Bol. Inform. Petroleras* (*B.A.*), July 1937, **14** (155), 1–157.—The value of the crude petroleum produced in the Argentine during 1936 amounts to Arg. $68,987,351 [*Note*: Arg. $16.75 = £1 approx.]. This production has shown a rapid increase in recent years, the total for 1936 being 2,457,545 cu. m., which represents an increase of 12·91% over 1933. The figure quoted includes the production from both State and privately owned fields. The latter is now actually showing a slight decline, but the State production continues to advance, as the following data show :—

	January to June.		Increase.	
	1936.	1937.		
Comodoro Rivadavia . . .	484,818	549,776	64,958	13·40%
Plaza Huincul	37,336	39,378	2,042	5·47%
Salta	15,856	24,991	9,135	57·62%
Mendoza	3,319	5,725	2,406	72·49%
Jujuy	—	153	153	—

The total value of the refined products sold by the State organization (Y.P.F.) reaches Arg. $88,491,292·61; petrol being sold at the low price of Arg. $0·23 per litre. The profit accruing to Y.P.F. during 1936 was Arg. $15,738,159·11, or 53·67% in excess of 1935.

A full account of the directorate and organization of the Y.P.F. is given, together with a *résumé* of the various decrees promulgated and contracts entered into with private companies producing and selling petroleum products in the Argentine.

Routine geological work has been carried out in the provinces of Salta, Jujuy, San Juan and Mendoza, and in the territories of Neuquén, Chubut and Santa Cruz; geological reconnaissances have been accomplished in Salta, Jujuy, Tucumán, Santa Fe, Córdoba, San Luis, San Juan, Formosa and Santa Cruz.

Geophysical investigations have taken place in the whole of the zone N. and N.W. of Santa Fe, using seismic, gravimetric and magnetometric methods. It has been proved that the Melaphyre key-horizon remains sensibly horizontal, but disappears a little to the N. of San Cristóbal, to the E. of Hersilia, and S.E. of Estaban Rama. In consequence of the results obtained, detail work is projected to start in November 1937 over an area of about 1600 sq. km. N.W. of San Cristóbal.

In the north the seismic commission has obtained results from the dolomitic–limestone horizon which caused difficulties last year; it has been able, now, to interpret deep structures in the Laguna de la Brea (Jujuy) zone. The gravimetric commission has studied a vast area in the Chaco Territory and has run profiles over 1400 km.

Topographic work has covered 4297 sq. km.

Aero-photographic surveying has been accomplished over two zones N.E. of Mendoza totalling 130 sq. km. The contact of the hills of Lunlunta with the plains has also been photographed. The photographs (overlap 60%) cover 287 sq. km. on an average scale of 1 : 13,000.

Exploratory Wells. At Comodoro Rivadavia 23 wells, of a total meterage of

33,973·30, were sunk. The results were eminently satisfactory, only 4 wells being non-producers. In addition, 13 wells were started but not completed by the end of 1936.

In Plaza Huincul 11 wells were completed, 4 of which had been started in 1935. Seven other wells were started but not completed during the year. Drilling is continuing on one well started in 1935. The total meterage drilled during 1936 is 9818·10.

In Jujuy 1 well is under test at 1592 m., 1 well has been abandoned and operations continue on 3 wells.

In Mendoza 8793 m. were drilled at Cacheuta and Tupungato, 913 m. at Pampa Amarilla and 758 m. at Ranchitos. Fourteen of the 16 wells completed were producers. Drilling continues on a further 5 wells.

Field Wells. At Comodoro Rivadavia 99 wells were drilled to a total meterage of 74,136 and 15 were deepened to a total extent of 3116 m. Of these 114 wells, 7 were non-productive. Results obtained indicate that deep drilling will ordinarily be necessary on this field in the future.

At Plaza Huincul 17 wells were completed and a total of 11,109 m. drilled. One rotary rig is being installed here, and it is anticipated that cable drilling will give place to rotary.

At Salta 6 wells (2 started in 1935) were completed, 4 wells were started and 8 were deepened. A total of 5647 m. was drilled during the year. The results indicate an extension of the field and increased production.

At Mendoza no wells that can be considered other than exploratory have been completed during the year.

State of Wells in the Argentine Government Oilfields as at 31.12.1935 *and* 31.12.1936.

Wells.	C. Rivadavia.		Plaza Huincul.		Salta and Jujuy.		Mendoza.		Total.	
	1935.	1936.	1935.	1936.	1935.	1936.	1935.	1936.	1935.	1936.
Producing oil	1431	1479	170	169	65	74	11	25	1677	1747
Producing gas or in reserve	13	17	5	5	—	—	—	—	18	22
Key wells for gas injection	33	28	9	17	—	—	—	—	42	45
Drilling	27	30	13	11	15	17	8	9	63	67
Rigs up	17	33	2	—	6	2	—	5	25	40
Derricks building	10	6	3	1	1	1	—	—	14	8
Deepening or testing	38	73	2	1	1	1	—	—	41	75
Temporarily suspended	212	227	23	40	15	15	1	—	251	282
Abandoned	258	279	57	65	17	17	10	12	342	373
In course of abandonment	3	7	4	3	—	—	3	3	10	13
Total	2042	2179	288	312	120	127	33	54	2483	2672

The increase in production has continued during 1936 at an accelerated rate, the year's total for the Government-owned fields being 20·8% over that of the 1935 figure.

In addition to those already in commission at La Plata, Plaza Huincul and Vespucio (Salta), new refineries are under construction at Godoy Cruz and at San Lorenzo (Santa Fe). The Godoy Cruz refinery should be opened in the first half of 1937, and will treat the output of Mendoza; the San Lorenzo plant is being built, as a precautionary measure, with the object of decentralizing refinery operations, and should be in service by the end of 1937.

In all the national refineries increased throughput is recorded; this is due not merely to the augmentation of crude oil production, but also to the enhanced demand for Y.P.F. products throughout the country. Details of the operation of the individual refineries are given. Substantial advances in technique have been made during the year, particularly with reference to diesel oil. The increased demand for "Supergas" is a notable feature.

The various decrees promulgated with reference to Y.P.F. activities are given in full in appendices. L. O.

1493. Petroleum Statistics of the Argentine Republic for 1936. Anon. *Direccion Minas y Geol.*, 1937, Publ. No. 115, 46 pp. + 3 plates.—The production of crude petroleum from all Argentine sources for 1936 shows an increase over the 1935 figure

of 184,568 cu. m., or 8·12%. This increase is mainly due to deepened wells in the existing Comodoro Rivadavia field, which accounts for 183,317 cu. m., or 10·11% of its 1935 production.

A new productive zone, "Bajo de los Baguales" in Plaza Huincul, is responsible for an increase of 19,680 cu. m., and Mendoza has increased its production by 4357 cu. m., or 51·03% over 1935.

On the other hand, Salta production has declined by 22,517 cu. m., or 7·40%, and Jujuy has ceased producing.

Exploratory work at Comodoro Rivadavia has led to the discovery of a promising structure at El Trebol, where well T.4 averages 100 cubic metres of oil daily.

Total production of crude petroleum from all fields for 1936 is 2,457,545 cu. m., of which the Government organization (Y.P.F.) is responsible for 46·4%. The Comodoro Rivadavia field is by far the largest producer, with 1,996,823 cu. m., of which the Y.P.F. share amounts to 1,018,299 cu. m.

Well No. 4, in the Santa Cruz Territory, is producing 1 cubic metre daily from a depth of 769 m. The liquid level remains stationary at 550 m., and the existence of a new pool here is suggested.

Intensive exploratory work is being undertaken by Y.P.F., Standard Oil, and Ultramar in the Salta Province. The Astra Co. has suspended operations here after drilling four wells.

Part of the Province of Córdoba (limits given) and the whole of the Province of San Luis are now reserved for Governmental exploitation of hydrocarbons.

The pamphlet is divided into seven sections, which give comprehensive data of drilling activities and production figures for crude petroleum, natural gasoline and gas throughout the republic. The several producing areas are treated in separate sections in which the following information is tabulated: Total Y.P.F. and private production of oil; natural gasoline and gas in each area for 1936; zonal and individual company production of crude oil, annually, from the inception; companies' monthly production figures for crude oil (1935–36) and of natural gasoline and gas (1936); number and state of wells at the end of 1935 and 1936. An appendix gives the stocks of petroleum and derivatives at the end of 1935 and 1936, the average number of persons employed by the various oil companies during 1936, throughput of refineries, and imports of crude petroleum and derivatives. L. O.

1404. Some Aspects of the Petroleum Problem in the Argentine Republic. A. M. Casariego. *Bol. Inform. Petroleras* (*B.A.*), June 1937, **14** (154), 3–6.—Through the Yacimientos Petroliferos Fiscales (Y.P.F.) organization, which represents an annual turnover corresponding to £7,812,500, the State controls directly all stages of the petroleum production of Comodoro Rivadavia, Plaza Huincul, Salta and Mendoza, including not only geological exploration and drilling but also refining, transport and marketing.

The Argentine petroleum policy is strictly nationalist, although it does not exclude foreign capital, and reserves the right to control the domestic oil market by regulating imports and prices and by other means.

The production of crude oil has increased considerably during the last few years, the total amount for all Argentine fields being 2,272,977 cu. m. in 1935 and 2,457,094 cu. m. in 1936, an advance of 8·10%. Over the same period the Comodoro Rivadavia production increased by 18·82%, a rate which still allowed of ample reserves.

The Chubut Territory has been the focus of intense geological studies and to-day covers the most important tapped oil reservoirs in the country. Similar developments in the other Argentine oil regions make it probable that the State possesses a vast reserve of petroleum which, in the next few years, will be sufficiently exploited to satisfy all domestic needs, and possibly those of neighbouring countries which lack indigenous supplies.

The Government grants import permits for petroleum and its derivatives to cover the existing deficit of national production in respect to domestic needs, but only to such companies as sign commercial agreements with Y.P.F., and it gives preference to those companies which produce Argentine crude or own refineries in the country.

The possibility that the Argentine domestic demand will soon be covered by domestic production of crude oil has probably influenced the decision of the Standard Oil

Company to offer all its Argentine properties and interests to the State in return for a sum of approximately £9,187,000. L. O.

1495. Price of Gasoline in Argentina. Anon. *Bol. Inform. Petroleras* (*B.A.*), September 1937, **14** (157), 143.—An agreement as to the sale of gasoline in the Argentine, signed by Yacimientos Petroliferos Fiscales, Standard Oil and Shell-Mex, is now in force. It fixes the price at 0·23 Argentine pesos per litre (equivalent approximately to 1*s.* 3*d.* per Imperial Gallon at the present rate of exchange) throughout the republic. This price is stabilized to 31st December, 1941. It is expected that the sales of gasoline in the Argentine during 1937 will exceed those of 1936 by from 50 to 70 million litres.

Any breaches of the agreement will be submitted to an Arbitration Tribunal, composed of representatives of the Y.P.F. and private companies, under the presidency of Dr. Eduardo Bullrich. L. O.

1496. Venezuelan Petroleum. E. Leupold. *Bol. Inform. Petroleras* (*B.A.*), June 1937, **14** (154), 8–50.—Since 1928 Venezuela has occupied the third place in world petroleum production, being about 150,000,000 cu. m. below that of U.S.A., and 5,000,000 cu. m. below that of Russia.

The main production centres round the Lake of Maracaibo, and, as much of the oil is obtained from wells drilled on the lake, Venezuela has been called the "Venice of Crude Oil."

In 1936 Venezuela produced 25,421,780 cu. m. of oil. In spite of this immense production, the local refinery industry is practically non-existent. The country thus obtains a minimum of benefit from the enormous source of wealth with which nature has endowed it.

A comparison between the Venezuelan and the Argentine petroleum legislation is made, and it is followed by a history of the various oil concessions.

The policy of the present Venezuelan Government is analyzed, and the opinion is expressed that it unduly favours foreign interests at the expense of the State. It is pointed out that the daily production of Venezuela is in excess of 70,000 cu. m. of crude oil daily, but the total domestic refinery capacity amounts to only 1430 cu. m. daily. In spite of this lack of facilities for local refining, the Standard Oil Company of Venezuela has been granted a concession of 400,000 hectares in return for the construction of a refinery capable of handling 2385 cu. m. daily, and that only when the production from the area conceded justifies it.

A list of 95 companies actually holding oil concessions in Venezuela, to a total extent of 17,020,423 hectares, is given.

The first oil concession (only 100 hectares in extent) in Venezuela was granted in 1878. Real interest, however, was not aroused until 1907, when European companies started to take up concessions. In 1936, the Standard Oil Group were responsible for 52·84% of the total production, the Royal Dutch-Shell Group for 36·58%, the Venezuelan Gulf Oil Company for 9·64%, the British Controlled Oilfields for 0·56%, and the North Venezuelan Petroleum Company for 0·38%.

The paper is illustrated by a production graph, a sketch map of the Venezuelan oilfields, a comparative table of Venezuelan and Argentine production and four photographs. L. O.

1497. Italian Petroleum Policy and the Carburant Problem. A. Tarchi. *Riv. Ital. Petr.*, October 1937, **5** (54), 1–5.—In Italy, reduction in the volume of imports may be effected by manufacturing equivalent products from domestic materials. Of these products, carburants form an integral element in the economic life and military power of the nation.

The normal requirements of Italy, in metric tons per annum, are: gasoline, 500,000; kerosine, 200,000; gas oil, 300,000; mineral oil (*Nafta*), 1,500,000; lubricating oils, 80,000; or a total of over two and a half million metric tons.

The importation figures for 1934 were as follows: crude petroleum, 145,000; lubricating oils, 66,000; kerosine, 150,000; gasoline, 350,000; fuel oil residue, 1,100,000; and bitumen, 110,000; making a total of 1,921,000 metric tons.

The following products were obtained from crude oil and fuel oil residues in the Italian refineries during 1934: gasoline, 126,000; kerosine, 40,000; gas oil, 40,000;

lubricating oils, 20,000; fuel oil, 70,000; in addition to coke, paraffin wax, bitumen, etc. Only 15,000 metric tons of carburant were produced from materials of Italian origin.

The changes necessary, in policy and organization, to meet this utter lack of self-sufficiency with reference to petroleum products are detailed, and the following substitutes for imported motor spirits are suggested: (1) alcohol mixtures, the alcohol being produced from cereals, molasses, beet, grape refuse, wine, etc., or synthetically; (2) synthetic carburants, such as synthetic methyl alcohol, gasoline synthesized from lignite, and oil or gasoline from asphalt rock; (3) natural gasoline; and (4) gas.

An analysis is given of the potentialities of the materials locally available and of the methods of producing these substances in sufficient quantity within Italian territory.

L. O.

1498. Mexican Petroleum Regulations. J. D. Baez. *Bol. Inform. Petroleras (B.A.)*, September 1937, **14** (157), 61–68.—In 1914 Mexico commenced to reform her social and economic organization, and an official inspectorate of oilfields was created. Rules pertaining to precautionary measures in high gas-pressure districts, to the quality of materials employed in drilling, to the adequate capping and sealing of abandoned wells, and to casualty prevention were formulated. Regulations were also drafted with reference to the maintenance and protection of pipe-lines and refineries.

In August 1915 maximum distances for well spacing and offsetting were defined, and in September 1916 the storage of petroleum in open reservoirs was forbidden, except as a temporary measure.

In February 1917 a most important step was taken by declaring that the regulation of the development of its natural resources, including petroleum and its derivatives, was the direct concern of the nation.

In April 1917 the precautionary measures necessary to safeguard against possible accidents and losses were made legally obligatory.

In July 1921 the construction of earthen reservoirs for petroleum was strictly forbidden.

In October 1922 the provisional permission to roof certain oil tanks with wood was withdrawn, and in November 1922 a time limit was fixed for the undertaking of improvements necessary to prevent the wastage of natural gas.

A measure of great importance was taken in March 1923, when the efficient sealing of dry or non-exploitable wells was made compulsory under bond.

A circular, dated November 1925, prohibited excessive production, and this was amplified in July 1926, when proration was fixed in accordance with productive capacity.

The petroleum law of December 1925 consolidated the various existing regulations, and the industry was placed definitely under federal jurisdiction.

Further regulations were announced in December 1927. These had for object the amplification and completion of the various dispositions designed to increase the benefits accruing from the oil resources of the country, of avoiding excessive production and waste, of protecting the health and life of employees, and of preventing injury to the property and interests of third persons.

Drilling regulations cover minimum spacing of oil wells, shutting-off of water sands, cementing and anchoring of casing, blow-out prevention, capping of abandoned wells, and methods and materials, generally.

Production regulations include the prevention of loss or waste of oil and wet gas, and the conservation of stripped gas except in special circumstances.

Storage regulations deal with the construction, design, protection and painting of tanks, and of the prevention of loss by leakage or fire.

In September 1930 a decree was promulgated authorizing the enforcement of unit development of oil-pools where such might be beneficial. L. O.

1499. Oil Concessions in Bolivia. Anon. *Rev. Petr.*, 8.10.37 (754), 1425.—The present oil situation in Bolivia is discussed, and it is considered that Bolivia has important resources in the La Plata, Amazon and High Plateau regions. The present oil policy of the Government is discussed. Development is hindered by the backward state of the country. R. O. Y.

1500. Petroleum Industry in U.S.S.R. I. Ganitski. *Mon. Petr. Roum.*, 1937, **38**, 1419–1420.—A decree of 22nd August, 1937, has reorganized the control of heavy industries in Russia. A separate commissar for machine construction has been appointed, leaving under Heavy Industries only (*a*) all aspects of fuel, (*b*) electricity, (*c*) metallurgy, (*d*) heavy chemicals and (*e*) non-metallic construction. The first two have long been the most remunerative branches, and the reorganization is expected to give them a still better chance of more than paying their way.

Crude oil production during the first six months of 1937 was only 13·90 million tonnes, against 13·68 million in 1936 and a programme figure for the year of 32·16 millions. The reorganization, plus the recent discovery of oil in the Tshernigov and Poltava regions of the Ukraine and in the Franz Joseph islands, is expected to have a favourable effect on the realization of the programme. W. E. J. B.

1501. The Petroleum Industry. J. Bermejo. *Bol. Inform. Petroleras* (*B.A.*), May 1937, **14** (153), 5–31.—A series of 24 plates illustrating: (1) the properties of petroleum, (2) oil-rocks, (3) oilfield structure, (4) oil finding, (5) percussion drilling, (6) rotary drilling, (7) and (8) cementing, (9) production, (10), (11) and (12) transport, (13) storage, (14) and (15) refining, (16) petroleum derivatives and their uses, (17), (18), (19) and (20) old and new uses for oil, (21) petroleum and national defence, (22) Argentine Government oilfields, refineries and tank farms, (23) and (24) Argentine and world production of petroleum.

The descriptions are elementary, but the 24 plates form an excellent illustrated basis for any oil-man who wishes to acquire a working knowledge of the technical terms in common use in the petroleum industry in Spanish-speaking countries.

L. O.

1502. Importance of Petroleum in Economics of Chile (Conclusion). T. G. Guevara. *Mon. Petr. Roum.*, 1937, **38**, 1397–1405.—In 1926 the State reserved for itself the right of exploration for oil, and cancelled all existing concessions not exploited in the course of the year. This meant all. A credit for 10 million pesos was granted for State activities in search of oil in 1928.

Figures are given of the coal production and utilization of the country. The only important field is in the province of Conception: most of the coal is used internally.

Particulars are given of transport facilities and the number of motor vehicles. The latter is decreasing each year owing to exchange restrictions.

Details of imports of oils and petrol for 1936 were as follows. 9½ million kgm. of crude oil, mainly from U.S.A., 88 million litres of petrol, from Peru, Mexico, and U.S.A., and 5½ million kgm. of solid paraffin from India, Great Britain and U.S.A.

The 35,370 motor vehicles in 1935 used an average of 2790 litres of petrol per year. The demands of the railways and aviation are comparatively small. Details of import duties are given, part of which has to be made in foreign currency; also of freights and railway charges.

The State reserves the right to build and work refineries. Details are given of the companies importing petroleum products, and of other laws and regulations governing the sale and transport. In conclusion, the author suggests than an agency for the import of Rumanian products should be established. W. E. J. B.

BOOK REVIEWS AND BOOKS RECEIVED.

Book Reviews.

(1) "Oil Production from Coal Viewed from an Australian Standpoint." Report by Sir David Rivett, Council for Scientific and Industrial Research, November 1936. Pp. 21. Commonwealth Government Printer, Canberra. Price 1*s*.

(2) "Oil from Coal," Second Report of the Committee Appointed to Enquire into the Question of Establishing a Plant in Australia for the Production of Oil from Coal by the Hydrogenation Process, June 1937. Pp. 6. Commonwealth Government Printer, Canberra. Price 6*d*.

These two reports are of special interest at the present time, because they describe in considerable detail the only two processes known so far for the complete conversion of coal into oil—namely, the Fischer–Tropsch Process and the Hydrogenation Process. Both of these processes are in operation on a commercial scale, and it is claimed that improvements have been made since the data given in this report were supplied. As the figures for costs are shown in the reports in Australian currency, having been obtained from the costs in £ sterling by multiplying the latter by 1·25, it should be noted that all the figures given in £A need to be reduced by 20% to convert them back into sterling.

(1) *The first of these reports* is a Preliminary Statement prepared for the Minister-in-Charge of the Council for Scientific and Industrial Research, by Sir David Rivett, D.Sc., who was instructed to make a survey of the position of the production of oil from coal, and seek such information abroad as was likely to be useful to the Minister in considering "the question of whether or not Australia should commence the manufacture of petrol, diesel oils, fuel oils, and, possibly, lubricating oils, from her coal; but particularly petrol."

Sir David Rivett's conclusions were arrived at after a detailed technical and economic investigation, comparison and discussion of low-temperature carbonization processes, hydrogenation and the synthesis of hydrocarbons from carbon monoxide and hydrogen (Fischer–Tropsch Process). He obtained most of his information at first hand, during a lengthy visit to Europe, where he visited numerous plants in operation, particularly those of Germany and Great Britain. Detailed estimates were obtained of capital and operating costs of plant for the hydrogenation of coal and also for the production of hydrocarbons by synthesis from certain gases.

The writer of this review can confirm the thoroughness of Sir David Rivett's investigation. Whilst preparing an article on "Oils from Coal" for *Petroleum Technology, 1936*, he found that wherever he went, at home or abroad, Sir David Rivett had previously been in his search for accurate information and advice. Directors and technical officers of many organizations visited referred to the pleasure it had given them to discuss their processes and problems with Sir David Rivett. His obvious keenness to leave no stone unturned to obtain the very latest information on general and technical points made a great impression, and one which will be long remembered.

Sir David prefaces his report by stating that "the relative costs and merits of different available processes in other countries must be used with caution" as a guide to conclusions regarding Australia, and his report shows that he has paid considerable attention to this point.

Similar caution should be used when considering oil production from coal from the standpoint of Great Britain.

As regards low-temperature carbonization of coal, as a source of petrol on a large scale, it is pointed out that this can be operated only when there is an economic outlet for the solid semi-coke, and no such economic outlet exists in Australia to-day, where there is only a small consumption of raw black coal in domestic grates and where there is relatively no smoke nuisance. He concludes that as a main means of meeting their petrol requirements in Australia, low-temperature distillation of coal must be ruled out. He admits that a hydrogenation plant could use the tars or a Fischer–Tropsch plant could use the coke, but he regards these as supplementary uses, which do not effect the main conclusion.

In dealing with the hydrogenation of coal, Sir David goes very fully into the capital and running costs, based on data supplied by the I.C.I. and by the I.G. at Leuna, for the treatment of both bituminous coal and Australian brown coal. He estimates the capital cost of entirely new self-contained plants, built on new sites, to produce about 45 million gallons or 150,000 tons per annum of petrol, consisting of No. 1 and No. 3 spirit to present specification, to be about A£11,000,000 for a bituminous coal plant and about A£12,000,000 for a brown coal plant, and the "all-in" running costs, including 3½% interest on capital, but excluding amortization, to be about 10·5*d.* per gallon in the first case and 10·8*d.* per gallon in the second case. Allowing 10 years for amortization, as suggested by I.C.I., at 2½% interest, this brings the total cost to 15·8*d.* per Imperial gallon for bituminous coal hydrogenation and 16·6*d.* per gallon for brown coal. The time required for the construction of either plant is estimated at approximately four years.

Sir David admits that there are arbitrary assumptions in the rough estimates given by him for the Fischer–Tropsch Process. In the conversion of German currency into sterling, the rate of exchange has been taken as £1 = RM. 12·58, and it is admitted that this also introduces an element of doubt into the total figures given for the costs of a Fischer–Tropsch plant. These are shown as about A£3,000,000 for a plant to produce 30,000 metric tons of primary products per year, dealing with about 700,000 cu. m. of gas daily, and his "all-in" operating costs, for what they are worth, are given as about A£230,000 per annum, making a total cost of 15·8*d.* per gallon of petrol, allowing 10 years amortization of the plant at 2½%. He points out that the hydrogenation petrol is definitely of a higher grade than the Fischer–Tropsch, as the latter is composed largely of paraffins and is of low octane rating. Whilst acknowledging the provision of a great deal of information on this process by the Ruhrchemie A.G., who hold all patents rights, Sir David adds: "It must not be assumed that a full account of the plant and its operation has been provided. There are many important points which the Company is not willing to disclose to any but those entering into a contract with it." It is stated that "The primary products consist of gas and a crude oil of which about 65% is raw petrol, 22–23% 'gas oil,' 2% paraffin wax melting at 52–54° C., and a certain amount, nearly 2%, of hard paraffin."

He considers that there is every reason to suppose that the Fischer–Tropsch Process may prove quite capable of yielding good lubricants, but that whether they would be good enough for aero-engines remains to be proved. *His general conclusion is that the cost of manufacture of petrol from coal, whether by hydrogenation or by the Fischer–Tropsch process, would appear to be about three times the cost of the imported product.* This statement, however, does not take into account the taxation imposed on spirit imported into Australia, which at present is equivalent to 7½*d.* per gallon.

Assuming a Treasury contribution of 8*d.* per gallon, Sir David Rivett shows, on page 19, that this represents £375 per man per annum for a hydrogenation plant producing 150,000 tons of petrol yearly and that another 1*d.* per gallon would bring this to over £420, which he considers a heavy charge for putting one man into employment. He says that he is credibly informed that in Australia not 2000 but only 1000 miners would be required to produce the necessary coal, and that this would reduce the total number of employees from 4000 to 3000 which would change the above figures to £500 and £560 respectively.

In the case of a synthetic plant producing 9,000,000 gallons of petrol yearly from brown coal, the total number of operatives is given as 200 and the subsidy from the Treasury amounts to no less than £1000 per man per annum.

Sir David concludes that no other consideration is possible than that from an ordinary commercial view the manufacture of petrol from coal is quite uneconomic when compared with its production from flow oil, and that even with 8*d.* per gallon subsidy, in the circumstances at present existing, "no wise Board of Directors would issue a prospectus with any hope of attracting capital." Finally he states quite definitely that both hydrogenation and synthesis are economically unattractive for the production of petrol from coal in Australia, and "must remain so until either their costs are materially reduced or competition petrol from flow oil approaches something like three times its present price."

He says: "I find myself quite unable to recommend that public money be provided at the present time for so costly a project as the making of petrol from coal. It is with an intense sense of disappointment that this conclusion is reached, for low-temperature carbonization, hydrogenation and synthesis are technically most attractive

lines of work, and all my prejudice has been in favour of a recommendation for the establishment of one or more of them. . . . If, however, the Government is to place a local product in a position to compete with an imported article at one-third to one-quarter of the cost, it will have to be for reasons that lie outside my province."

This disappointing conclusion does not mean that nothing need now be done. He recommends that further investigations of selected Australian coals should be undertaken by both the I.C.I. and the I.G. to fill certain gaps in existing knowledge; that oil from coal matters should be kept continuously under review and reported on at intervals to the Commonwealth Government by a small committee of competent people, and that continuous contact should be made with the synthesis plants which are developing so rapidly in Germany.

In this last connection he considers that a large-scale test of the Fischer–Tropsch Process in a British country would be very valuable. "If the United Kingdom is hesitant about investigating this, we and other Dominions might offer to share in the cost. Such a test would be of great use all round."

(2) *The second of these reports* deals with the hydrogenation process only.* It has been presented by a Committee which was appointed in 1934, consisting of eight members, who are representatives of the Governments of New South Wales, Victoria, Queensland, South Australia and also of the Department of Defence. The Chairman of this Committee is Sir David Rivett, D.Sc.

In the first report, dated September 1934, it was stated that, on the evidence available to it at that time, it was quite impossible to make recommendations as to the erection of oil-from-coal plants in Australia. The Committee, therefore, adjourned until such time as additional evidence could be provided for it. This additional evidence has been supplied by the two members of the Committee, Sir David Rivett and Dr. Herman, who visited Great Britain and the Continent in 1937, where they studied the progress made and obtained as much information as possible on both the hydrogenation and the Fischer–Tropsch Process. This additional information has enabled the Committee to give much more definite answers to the questions which were originally placed before it in 1934 by the Prime Minister's Department. These questions included:

(1) The estimated cost of production in Australia for a hydrogenation plant capable of using about 1000 tons of coal per day;
(2) The most suitable location;
(3) The estimated number of men who will find employment and any other advantages likely to accrue as a result of the installation of the plant;
(4) The estimated amount of production and/or subsidy which would be required in connection with such an enterprise.

The Committee expresses its general agreement with the views expressed in Sir David Rivett's report, which was referred to it by the Cabinet.

In considering (1) the estimated cost of production, the Committee increased the amortization period to 15 years in place of 10 years fixed by the I.C.I., which it considered too short a time in view of the fact that the Leuna plant has already been in operation for some nine years. It has thereby reduced the total cost of petrol to 13·8*d.* per Imperial gallon for the hydrogenation of bituminous coal and 14·4*d.* for brown coal, as against 15·8*d.* and 16·6*d.* per gallon respectively shown in Sir David Rivett's report, when only 10 years was allowed for amortization.

The Committee refrains from saying what return on capital would be required if private enterprise were to establish this industry. It takes 3½% as the interest on capital, but points out that this low rate of interest is probably lower than that at which any Government could obtain funds at the present time. It has also worked out the costs based on 10 years for amortization on a hydrogenation plant as given by the I.C.I. and with a return on capital of 6% and also of 8%, and the totals become 17·3*d.* and 18·2*d.* per gall. for the hydrogenation of bituminous and brown coal, respectively, in the first place and 18·5*d.* and 19·4*d.* in the second place.

With regard to the Fischer–Tropsch synthetic process, the Committee has allowed 15 years for amortization and 3½% interest on capital, and has thereby arrived at a

* All costs mentioned in this report are in Australian currency. 1£A equals approximately 16/– sterling.

total cost per gallon of petrol of 13·0*d*. If 6% be charged on capital and the plant amortized in 10 years, this total becomes 17·7*d*. per gall.; whilst at 8% on capital and amortization in 10 years it reaches 19·3*d*.

The Committee emphasizes that in all these estimates the figures are only approximate, and that the order of uncertainty is probably greater in the case of synthesis than with hydrogenation.

As regards (2) the most suitable location and the time in which the plant should be erected, the Committee is of the opinion that discussion on these would be premature.

The Committee's information shows that a hydrogenation plant working on brown or black coal would employ 2000 men, and in addition some 1200 persons would be employed in winning black coal required for the production of 150,000 tons of petrol per annum, whilst 200 men would suffice for similar petrol production from brown coal.

In regard to the question of other advantages likely to accrue to Australia, the Committee refers to the many factors involved, and says that the possible difference of opinion on these matters is so wide that it does not feel disposed to pronounce definitely upon them or even to endeavour to assess them collectively. One of the factors referred to is the importance of having in the country a body of skilled chemists and chemical engineers, such as would be associated with an oil-from-coal industry.

It is stated that subsidies would have to range from 8·8*d*. to 13·5*d*. per gallon for hydrogenation of black coal, according to the conditions assumed from the figures quoted, and from 9·4*d*. to 14·4*d*. per gallon for hydrogenation of brown coal.

The corresponding range for the synthetic process is 8·0*d*. to 14·3*d*. These subsidies are based on a c.i.f. price of petrol in Australia of approximately 5*d*. per gallon. The Committee arrives at the same costs of putting men into employment as those given in Sir David Rivett's report, which vary from £470 per annum per man where black coal is hydrogenated to £1200 per man per annum where the petrol is made from brown coal by the Fischer–Tropsch Process, in each case based on the minimum subsidy of 8*d*. per gallon.

The report directs special attention to the same suggestions for immediate action as those given in Sir David Rivett's report, and concludes by saying "the Committee is of the opinion that means should be devised to enable the Commonwealth and State Governments to be kept adequately posted in developments abroad in processes for the production of oil from coal. To that end, one or possibly two experienced technical officers should be appointed, the whole of whose time should be devoted to the object."

W. H. CADMAN.

THE MECHANICS OF PROSPERITY. Hobart C. Dickinson. Pp. xvi + 136; 8¼″ × 5¼″; Williams & Wilkins Company, Baltimore, 1937. Price: $2.00.

The question which invariably confronts a mind trained in the deductive sciences when dealing with economic problems is: Why is it not possible to postulate definite laws in economics as it is in science? If the principle of the conservation of energy can be regarded as an immutable natural law, why cannot the processes of logic lead up to an equally immutable law of the conservation of money? Mr. Dickinson may or may not have been aware of this dilemma. He has, however, produced a book which is to be welcomed as indicating the impact of the scientist on the realms of the economist.

As Chief of the Division of Heat and Power, National Bureau of Standards, U.S.A., Chairman of the Highways Research Board, National Research Council and a physicist of wide repute, he is well known to many members of the Institution. In his present volume he outlines briefly a philosophy of the working of the monetary system under competitive conditions, treating the problem as in the "exact" sciences. The concepts of work, money, banking, Government funds, and trade are introduced into a flow diagram of a type more familiar to the engineer than to the orthodox economist. A comparison with the classical economics of Adam Smith and Karl Marx is introduced, and it is shown that the theories of these earlier economists are not applicable to a dynamic system, particularly one that is marked by the phenomenon of trade cycles.

Such a method of approach is bound to be both provocative and stimulating. Unfortunately for the enthusiast for the scientific treatment of sociological problems, the data of economics, unlike those of the physical sciences, are only partly capable of quantitative expression. The psychological factors, which are the real causes of the

ebb and flow of human welfare, cannot be measured with such exactness. The author appears to accept the "cost-of-production" theory of value. "A man who buys a product pays for all the work that has gone into it. . . . If less money is paid for work, prices fall." On this controversial basis, a theory is developed which leads to the somewhat startling conclusion that the cause of the decline of civilizations is a rate of interest insufficiently elastic.

The book deals mainly with American conditions. The English reader, accustomed to an elaborate system of social services for pensions, unemployment relief, sickness benefit and public assistance for the poor, cannot help feeling a sense of gratitude to a system which does not have to depend on "the level of generosity of society" for relieving its less fortunate members.

S. J. Astbury.

Books Received.

Scottish Development Council Economic Series, No. 14. Third Report of the "Oil from Coal" Committee (Revised). 1937. Pp. 46. Scottish Development Council, 75, Bothwell Street, Glasgow, C.2. Price 6*d*.

This Report includes an account of an investigation conducted by a specially appointed Coalmasters' Sub-Committee to obtain more definite information on the demand for smokeless fuel in Scotland, and the relation of this demand to the practicability, from an economic point of view, of setting up a plant for the manufacture of this material.

Two classes of coal suitable for low-temperature carbonization processes, semi-coking and non-coking, are available in Scotland, and the problems before this Sub-Committee were, therefore, first, to select suitable processes for the treatment of each of these two classes of coal; second, to select suitable coals of these classes for the tests; third, to arrange for the distribution of the resultant smokeless fuels in various districts in Scotland with a view to ascertaining the market value and demand for fuels of the grade manufactured; and fourth, to arrange for the purchase of the coals selected and for the financing of the whole investigation.

These problems are dealt with in the report. From the data presented the conclusion is reached that none of the smokeless fuels can be produced at an economic figure under present-day conditions.

The Effect of Impurities in Copper. S. L. Archbutt, F.I.C., and W. E. Prytherch, M.Sc. Foreword by Dr. H. W. Brownsdon. Introduction by Dr. C. H. Desch, F.R.S. Pp. 128. Index 129–134. Illustrations 44, including 12 plates. Tables 51. British Non-Ferrous Metals Research Association, Regnart Buildings, Euston St., N.W.1. Price 12*s*. 6*d*.

This book gives the results of a comprehensive study of the effects produced by various elements added to copper one at a time starting with oxygen, then in pairs, and subsequently three at a time, four at a time and seven at a time. For each element or group of elements the investigation generally included: Preparation (melting) and casting. Chemical analysis of the castings. Hot rolling. Cold rolling. Density of castings and rolled rod. Tensile tests at ordinary temperature and at 250° C. Hardness tests. Fatigue tests. Notched bar impact tests. Electrical conductivity tests. Macrostructure of castings. Microstructure of material in various conditions. Solubility of the element or elements in solid copper.

The research was mainly directed to investigation of the rolling behaviour of cast billets and the properties of the rolled product.

The Lovibond Comparator for Colorimetric Determinations. The Tintometer Ltd., Milford, Salisbury.

This pamphlet describes the Lovibond Comparator and its various applications, with full instructions for carrying out the tests enumerated. Among the latter may be mentioned: determination of the p_H of the soil, quantitative colorimetric analysis, determination of the activity of carbon and other sorbtive materials, checking of sand and the grading of commodities.

THE STORY BOOK OF OIL. Maud and Miska Petersham. Pp. 32. J. M. Dent & Sons, Ltd. 2s. 6d.

This book is one of a series dealing with the principal products of commerce—coal, iron and steel, gold, etc., written for children of eight to ten years. It is an interesting example of present-day school methods of teaching geography and elementary science as subjects immediately related to the world around us. The only serious error in the text is the confusion of "tar" and "bitumen."

MEMOIRS OF THE FACULTY OF SCIENCE AND ENGINEERING, WASEDA UNIVERSITY, TOKYO, JAPAN. No. 12. 1937. Pp. 191 + 9.

In this number are presented abstracts of the scientific papers which have been issued by the Department of Applied Chemistry, Waseda University, and published in authoritative journals of chemical industry during 1934–1937. Among the papers may be mentioned the following:—Synthesis of Liquid Hydrocarbons from Natural Gas (Reps. 1–5); Difference of the Decolorizing Action of Japanese Acid Clay on Aqueous Solution of Methylene Blue and Petroleum Oils; Characteristic Decolorizing Experimental Formula of Various Adsorbents for Coloured Kerosine; Applications of Anhydrous Aluminium Chloride in the Petroleum Industry; Catalytic Action of Japanese Acid Clay on Vapour Mixtures of Aniline and Methyl Alcohol.

REPORT OF THE FUEL RESEARCH BOARD FOR THE YEAR ENDED 31ST MARCH, 1937, WITH REPORT OF THE DIRECTOR OF FUEL RESEARCH. Pp. 213. Figs. 24. H.M. Stationery Office, London. Price 3s. 6d.

The Report of the Board is a broad survey of the Fuel Research programme, bringing out the salient points and showing their relationship to the requirements of industry, while the Director's report gives fuller details of all the work in hand and of the progress made during the period under review.

Steady progress is reported in the Coal Survey, which consists in the detailed examination of the coals of this country, both as they occur below ground and as they are marketed at the pithead.

Three types of process for the production of oil from coal are under investigation—carbonization, hydrogenation and the synthesis of carbon monoxide and hydrogen.

The production of motor spirit by hydrogenation is being studied both directly by the hydrogenation of coal and indirectly by the hydrogenation of the tars produced by the carbonization of coal. During the year the suitability of different tars and coals for this treatment has been studied. It has also been established that, by the choice of suitable catalysts and operating conditions, the properties of the products may be varied to suit particular needs.

The use of fuels, other than liquid fuels, for motor transport is being studied, including the use of gas-producers consuming solid fuel.

STATISTICAL YEAR-BOOK OF THE WORLD POWER CONFERENCE. Edited by Frederick Brown, B.Sc. (Econ.), F.S.S. Pp. 132. The Central Office, World Power Conference, 36, Kingsway, W.C., 1937. Price 20s.

Statistics are given of the resources, production, stocks, imports, exports and consumption of power and power sources in all countries of the world for which it was possible to obtain information. Statistics relating to coke and manufactured gas are included for the first time.

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INSTITUTION NOTES.

JANUARY 1937.

FORTHCOMING MEETINGS.

Tuesday, 9th February, at 5.30 p.m. at the Royal Society of Arts, John Street, Adelphi, W.C.2. **"The X-Ray Examination of Paraffins,"** Dr. A. Muller (Royal Institution).

Light refreshments provided from 5.0 to 5.30 p.m.

Tuesday, 9th March, at 5.30 p.m. at the Royal Society of Arts, John Street, Adelphi, W.C.2.

Annual General Meeting.

Northern Branch.

Wednesday, 17th February, at 7.0 p.m. at the Engineers Club, Albert Square, Manchester. **"Engine Testing,"** by Mr. H. R. Ricardo, F.R.S., Hon.Mem.Inst.P.T.

Students' Section (London Branch).

Thursday, 4th February, at 6.15 p.m. at the Institution offices, Aldine House, Bedford Street, W.C.2. **"Knock Testing,"** by Mr. G. M. Barrett, B.Sc., Stud.Inst.P.T.

Friday, 26th February, at 6 p.m. at the Institution. Annual General Meeting, followed by a Paper by Mr. E. N. Tiratsoo, Stud.Inst.P.T.

CANDIDATES FOR ADMISSION.

The following have applied for admission to the Institution, or transfer to another grade of membership, and in accordance with the By-Laws the proposals will not be considered until after the lapse of at least one month subsequent to the issue of this Journal, during which any Member or Associate Member may communicate by letter to the Secretary, for the confidential information of the Council, any particulars he may possess respecting the qualifications or suitability of any candidate.

The object of this information is to assist the Council in grading candidates according to the class of membership.

The names of the candidate's proposer and seconder are given in each case, except as provided by By-Laws, Sect. IV. 3.

BOWRING, Frederick Beakbane, Refinery Assistant, Trinidad Leaseholds, Ltd., Point-a-Pierre, Trinidad, B.W.I. (*C. E. Inglis ; P. W. Wood.*)

BURGESS, Stanley Grove (Trans. from Assoc.Mem.), Chemist (*London County Council*), 26, Eastbourne Gardens, East Sheen, S.W.14. (*J. Kewley ; S. J. M. Auld.*)

CHALK, Leslie James, Chemist, c/o The Geochemical Laboratories, 92, Victoria Street, S.W.1. (*H. B. Milner ; J. J. Fox.*)

CHARLTON, Henry Ernest, Engineer (*Aquila Refinery, Trieste*), via Scorcola 13, Trieste, Italy. (*Harold Moore ; E. Stokoe.*)

CORDOVA, Eric Mortimer, Refinery Supervisor (*Shell Refineries, Stanlow Installation*), 1, Estrand Terrace, Whitby, Wirral, Cheshire. (*F. Mackley ; E. J. Dunstan.*)

DODDS, Eric, Chemist (*Universal Process Development Co.*), "Casila," 15, Harvard Road, Isleworth, Middlesex. (*W. E. Gooday ; Frank Levy.*)

EGG, Russell Armstrong, Clerk (*Shell Co. of Australia, Ltd.*), 62, Tryon Road, Lindfield, Sydney, N.S.W., Australia. (*R. K. Murphy ; H. A. Banks.*)

FALLAH, Reza (Trans. from Student), Chemist, Anglo-Iranian Oil Co., Ltd., Abadan, South Iran. (*G. L. Kennaby ; W. J. Galloway.*)

FREEMAN, Harold Arthur, Engineer, Iraq Petroleum Co., Ltd., Kirkuk, Iraq. (*D. Comins ; H. W. Hole.*)

HOBSON, George Douglas, Geologist (*Royal School of Mines*), 51, Lavengro Road, West Norwood, S.E.27. (*V. C. Illing ; P. G. H. Boswell.*)

HUGHES, Archibald Cecil, Engineer (*Hampshire C.C.*), The Castle, Winchester. (*L. G. Gabriel ; A. W. Attwooll.*)

LOOMIS, Albert Geyer, Chemist, Shell Development Co., Emeryville, Calif., U.S.A. (*E. C. Williams ; P. D. Foote.*)

LAVINGTON, Hugh Vaughan, General Manager, Trinidad Petroleum Development Co., Ltd., Palo Seco, Trinidad, B.W.I. (Trans. from Associate Member). (*G. H. Scott ; H. D. Fletcher.*)

MCCARTHY, Michael Phillips, Engineer, Burmah-Shell House, Connaught Circus, New Delhi, India.

RAIMES, Percy Hails, Engineer (*Texas Oil Co., Ltd.*), 101, Eden Way, Beckenham, Kent. (*N. L. Anfilogoff ; L. G. M. Roberts.*)

SCOTT, Edwin Cooper, Geologist, Trinidad Leaseholds, Ltd., Pointe-a-Pierre, Trinidad, B.W.I. (*F. L. Melvill ; A. G. V. Berry.*)

SHAW, William George, Refinery Assistant, Trinidad Leaseholds, Ltd., Pointe-a-Pierre, Trinidad, B.W.I. (*C. M. Sleeman ; C. J. Potts.*)

VERDONK, Gysbert (Trans. from Student), Engineer, 64, Graaf Wuhmanlaan, Bussum, Holland. (*H. I. Waterman ; W. J. Hessels.*)

WEST, Benjamin Williams, Engineer (*Antilles Petroleum Co. (Trinidad) Ltd.*), 7, High Street, San Fernando, Trinidad. (*H. C. H. Thomas ; M. A. ap Rhys Pryce.*)

WEST, Harry Longhurst, Chemist (*Anglo-American Oil Co., Ltd.*), 132, Huxley Road, Edmonton, N.18. (*J. S. S. Brame ; S. E. Bowrey.*)

ARTHUR W. EASTLAKE,
Honorary Secretary.

PERSONAL NOTES.

R. P. BOLTON has left for Roumania.

A. D. COOPER has left for Egypt.

G. DICKINSON has left for Venezuela.

J. M. MUIR has left for Australia.

H. W. REID is home on Leave.

P. J. WARD has left for India.

The Secretary would be pleased to have the addresses of the following members: H. J. HALLE, I. C. LOW, S. NICOL, M. I. OREVICEANU, M. A. SAIB, H. N. SHER, K. A. SPEARING, and M. L. THOMAS.

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BRANCH NOTES.

Burma Branch.

On the 30th October, 1936, Dr. J. T. Evans presented a paper to the members of the Burma Branch at the Volunteer Club, Yenangyaung, on "The Preparation and Control of Mud Fluid for Pressure Drilling Conditions."

In the subsequent discussion Messrs. W. E. V. Abraham, J. A. Butlin and J. Coates took part.

A further contribution to this series of papers on deep drilling problems was a paper by Mr. G. F. Wilson, B.Sc., on "The Drilling of a Deep Pressure Well in India."

This paper was presented at a meeting at the B.O.C. Club, Chauk, and in the absence of the author, was read by Mr. E. Procter. 40 Branch members and visitors were present, and the paper was followed by a discussion in which Messrs. Butlin, Armstrong, Stone, Grindle, Day, Mosley and Keep took part. Mr. Schmittou, who had been driller in charge of operations on the well, replied on behalf of the author.

Trinidad Branch.

The Ninth Annual General Meeting of the Trinidad Branch was held at the Apex Club, Fyzabad, on 2nd December, 1936, Commander H. V. Lavington, R.N., in the Chair.

The Report of the Committee and Accounts for the year ended 31st October, 1936, were approved and adopted. Messrs. F. Middleton and D. M. Walsh were elected Hon. Auditors for the ensuing year.

The following members of the Committee, retiring under the Rules of the Branch, were re-elected: Messrs. L. A. Bushe, J. Lonsdale Harris and E. Cooper Scott.

At a subsequent meeting of the Committee of the Branch, Mr. A. J. Ruthven Murray was elected Branch Chairman for the Session 1936–37, and Mr. H. W. Reid was re-elected Hon. Secretary and Treasurer. Mr. W. N. Foster (Petroleum Office, San Fernando, Trinidad) will act as Hon. Secretary of the Branch during the absence of Mr. H. W. Reid in England on leave.

After the Annual General Meeting, Mr. R. L. Brooks, Dip.For.(Edin.), Conservator of Forests in Trinidad, delivered a very interesting paper on "Forestry in Relation to the Petroleum Industry."

Students' Section (London Branch).

The special Prize offered by the Branch Committee of the Students' Section (London Branch) for the best contributions to the Discussion from a Student Member of the Institution, has been awarded to Mr. H. E. W. Kirby, Stud.Inst.P.T.

INSTITUTION NOTES.

FEBRUARY 1937.

FORTHCOMING MEETINGS.

Joint Meeting. Tuesday, 2nd March, 1937.—At the Royal Geographical Society's Rooms, Kensington, at 7.0 p.m., at a Joint Meeting with the Institution of Automobile Engineers and several other Societies, a symposium on **"Research in Relation to the Motor Vehicle"** will be presented at which the following papers will be read :—

Section 1. **"Some Factors Affecting Design,"** by Mr. C. G. Williams, Director of Research, I.A.E.

Section 2. **"Fuels and Lubricants,"** by Dr. F. H. Garner, Chief Chemist, Anglo-American Oil Co., Ltd.

Section 3. **"Materials with Special Reference to Steel,"** by Dr. T. Swinden, United Steel Co.s Ltd., to be followed by a discussion.

The Chair will be taken by Sir William J. Larke, K.B.E.

Advance copies of these three papers can be obtained on application to the Secretary of the Institution of Petroleum Technologists.

Tuesday, 9th March, at 5.30 p.m. at the Royal Society of Arts, John Street, Adelphi, W.C.2.

Twenty-Fourth Annual General Meeting.

Induction of Incoming President.

Presentation of "Redwood Medal" to Mr. H. Ricardo, F.R.S.

Light refreshments provided from 5.0 to 5.30 p.m.

Tuesday, 27th April. Symposium of papers on **"Deep Drilling Problems."**

Full particulars of the programme of this meeting will be announced later.

Please note alteration of date.

NORTHERN BRANCH.

Friday, 5th March, at 7.0 p.m. at The Engineers' Club, Albert Square, Manchester. **"Industrial Solvents,"** by F. N. Harrap, M.Sc., F.I.C.

Tuesday, 16th March, at the Midland Hotel, Manchester, **Annual Dinner.**

NEW MEMBERS.

The following elections were made by the Council in accordance with the By-Laws, Section IV, para 7, at the Council Meeting held on 21st January, 1937.

Elections are subject to confirmation in accordance with the By-Laws, Section IV, paras 9 and 10.

Members.

MYDDLETON, William Whalley	Kingston-on-Thames.
NEVILLE, Warwick	Minatitlan.

Transfer to Member.

READ, Alfred Leonard	Enfield.

Associate Members.

MACKLEY, Kenneth John	Gravesend.
WOOLER, John	Dundee.

Transfer to Associate Members.

CATCHPOLE, William Marcus	Sunbury-on-Thames.
HYDE, John Welford	Surbiton.
WITHERS, John Granville	Sunbury-on-Thames.

Associate.

HARRISON, Col. Christopher Heathfield	Simla.

CANDIDATES FOR ADMISSION.

The following have applied for admission to the Institution, or transfer to another grade of membership, and in accordance with the By-Laws the proposals will not be considered until after the lapse of at least one month subsequent to the issue of this Journal, during which any Member or Associate Member may communicate by letter to the Secretary, for the confidential information of the Council, any particulars he may possess respecting the qualifications or suitability of any candidate.

The object of this information is to assist the Council in grading candidates according to the class of membership.

The names of the candidate's proposer and seconder are given in each case, except as provided by By-Laws, Sect. IV. 3.

BAGG, Douglas Gordon, Chemical Engineer, c/o Trinidad Leaseholds, Ltd., Pointe-a-Pierre, Trinidad, B.W.I. (*O. C. Elvins; H. M. Stanley.*)

BROWN, William David, Economist (*Anglo-Iranian Oil Co.*), 42, Westbere Road, West Hampstead, London, N.W.2. (*A. E. Dunstan; B. R. Jackson.*)

CATINARI, Juan Norberto, Engineer (*Argentine Government Oilfields*), Bush House, London, W.C.2. (*Cecil W. Wood; C. T. Longcroft.*)

CHAPMAN, Alexander Hamilton, Production Consultant (*Anglo-American Oil Co.*), 36, Queen Anne's Gate, S.W.1. (*D. S. Paul; Ashley Carter.*)

DOUGLAS, Frederick Studdert, Civil Engineer, Anglo-Iranian Oil Co., Abadan, South Iran. (*G. E. Wheeler ; R. E. Adlington.*)

JAFAR, Dhya Ul-Deen, Engineer, 100/1, Kerkh, Baghdad, Iraq. (*A. W Nash ; L. V. W. Clark.*) (*Trans. : from Student.*)

JOHNSON, Norman Malcolm, Engineer, Anglo-Iranian Oil Co., Masjid-i-Sulaiman, South Iran. (*J. M. Pattinson ; A. N. Baylis.*) (*Trans. : from Student.*)

LAWRENCE, Albert Edward Thomas, Chemist (*British Bitumen Emulsions, Ltd.*), "Iona," 30, Lake Avenue, Slough, Bucks. (*I. Cameron ; F. H. Garner.*)

MAYO, Frank, Chemist (*Agwi Petroleum Co.*), Orchardlea, Fawley, nr. Southampton. (*A. W. Nash ; L. V. W. Clark.*) (*Trans. : from Student.*)

POORTEN, A. C. ter, Chemical Engineer (Bataafsche Petroleum Maatschappij), Tjepoe, Java, D.W.I. (*H. I. Waterman ; W. J. Hessels.*) (*Trans. : from Student.*)

ROBERS, Douglas Charles, Student (*Royal School of Mines*), Coniston, King's Drive, Eastbourne, Sussex. (*V. C. Illing.*)

ROSAIRE, Esme Eugene, Geophysicist (*Independent Exploration Co.*), Esperson Building, Houston, Texas. (*D. C. Barton ; W. E. Pratt.*)

SMOLEY, Eugene Ralph, Chemical Engineer, Lummus Co., 50, Church Street, New York, U.S.A.

STAINFORTH, Robert Masterman, Student (*Royal School of Mines*), South Kensington, S.W.7. (*V. C. Illing.*)

TEMPLETON, James Clark, Geophysicist, International Geophysical Prospecting Co., 9/11, Copthall Avenue, E.C.2. (*Sir John Cadman ; C. Dalley.*) (*Trans. : from Associate Member.*)

WRAY, Anthony Tom, Chemist (*Anglo-Iranian Oil Co.*), 87, Horsham Avenue, Friern Barnet, N.12. (*H. C. Rampton ; J. G. Withers.*)

WYKEHAM-MARTIN, Dennis Fiennes, Student (*Royal School of Mines*), 3, Philbeach Gardens, Earl's Court, S.W.5. (*V. C. Illing.*)

ARTHUR W. EASTLAKE,
Honorary Secretary.

ROUMANIAN BRANCH.

The Tenth Annual Dinner of the Roumanian Branch was held at the Piccadilly Restaurant, Ploesti on Saturday, 12th December, 1936, and was well attended by Members and Guests, of whom the principal were :

Sir Reginald Hoare . .	British Minister.
Dr. Nubrecht . . .	Dutch Minister.
Mr. Tantareanu . . .	Director of Mines.
Mr. Bujoiu	General Manager of "Petrosani."
Mr. Pennescu-Kertsch .	President of Chamber of Commerce.
Mr. A. Beeby Thompson .	Member of Council, London.

The principal speech of the evening was made by Mr. E. C. Masterson in proposing the toast of the "Petroleum Industry of Roumania."

It is hoped to give a full report of this speech in a forthcoming issue of the *Journal*.

The toast of "The Institution of Petroleum Technologists" was proposed by Mr. Pennescu-Kertsch, and replied to by Captain J. E. Treacy.

MEETING IN AMERICA.

The second meeting of the Members of the Institution of Petroleum Technologists in the United States was held in the Hotel Stevens, Chicago, on the 10th November, 1936. Dr. Gustav Egloff, Universal Oil Products Company, presided, and Dr. R. E. Wilson, Vice-Chairman of the Pan-American Petroleum and Transport Company, acted as Toastmaster of the meeting.

At the beginning of the meeting Dr. Egloff read a cablegram of good wishes from Sir John Cadman, President.

Dr. R. E. Wilson, after referring to the international aspects of the second meeting of the Institution in the United States, gave a short address on " How to Run a Research Department." In his remarks he stressed the importance of taking a long view in attacking all problems of research. Research, in his opinion, should never be hurried nor disturbed.

Mr. G. H. Coxon (Member of Council) then addressed the meeting. An English visitor, said Mr. Coxon, saw great progress being made in oil research in the United States. Nevertheless, the industry needed " Super-research " to tell them where it was going. More markets were required for petroleum. One instance of a market of future possibility was the auto-gyro; another was the gas turbine. The large oil companies needed a research committee to plan for the future.

Conditions in the motor-car industry in Europe had clearly demonstrated that the C.F.R. Motor method for rating gasoline was not satisfactory. Where higher octane spirits were called for, the present tendency was to revert to the Research method, which had shown itself to be a better index of road performance.

With regard to aviation spirits, high octane raw materials, important as they were for all countries, were not directly available in many countries. The tendency for Air Ministries to develop war-time aircraft to depend absolutely upon these high octane fuels was likely to produce serious trouble. Quantities of such high octane fuels were not available to build up large stocks in such countries, and it was advisable for those in charge to consider this angle very carefully.

Following Mr. Coxon, Professor V. N. Ipatieff of the Universal Oil Products Company gave an account of some of his experiences with the Russian Oil Industry when kerosene was the primary product obtained from crude oil. Two-thirds of Russia's oil interests were held by the Nobel Company. Prior to 1901, Russia occupied first place in world production of petroleum. In 1910, Professor Ipatieff became interested in the chemistry of oil, and in the following years served as consultant for the Nobel Company until the revolution. Two important processes studied were : the pyrolysis of petroleum distillates of no market outlet, and the aromatization, in 1914, of oil into benzene, toluene and xylene for war purposes. A 25 per cent. yield of aromatics was obtainable. The first five years of the

revolution were accompanied by an increase in total production of crude petroleum from 8 to 28 million barrels annually. In 1932, under the first five-year plan, production rose to 180 million barrels, which further increased to 300 million barrels during the second five-year plan. Professor Ipatieff's point of view of the petroleum industry was that there should be thorough chemical investigation of processes. New reactions of hydrocarbons were being sought and catalytic methods chosen.

In the absence, owing to illness, of Mr. T. A. Boyd, General Motors Research Corporation, a short address which had been prepared by Mr. Boyd was delivered by Mr. W. G. Lovell. He referred to the necessity of keeping in touch with the requirements of the gasoline and lubricating-oil markets. Another problem was the discovery of the decomposition and recombinations of molecules to give a cheap fuel with "proper characteristics." It was important that lubricating oil should function perfectly under specified conditions. The oil industry stood in need of more research and adaptation of scientific methods.

Mr. C. A. P. Southwell (Member of Council) said that he found little differences between the oil men of various countries, all of whom spoke the same technical language. He referred to the drilling campaign for petroleum which is now being conducted in England. Unit operation had been rendered possible by wise legislation, thus eliminating some problems of ownership. The question whether or not commercial oil was present still remained unsolved, but they were all hopeful that oil would be discovered. Mr. Southwell referred to the indebtedness of the world petroleum industry to the United States for the discovery of so many new tools for oil location.

In conclusion, Mr. W. D. Skelly (President of the Skelly Oil Company) expressed the hope that it would be possible to hold the World Petroleum Congress in Tulsa, Oklahoma, in 1940, in order to take advantage of the Oil Exposition which would be held in Tulsa in that year.

After the meeting a short business session was held by the members of the Institution present. It was unanimously decided that a yearly meeting of the Institution of Petroleum Technologists be held during the period of the national sessions of the American Petroleum Institute, in the same manner as the 1935 meeting in Tulsa and the present meeting in Chicago. Dr. Gustav Egloff was elected honorary correspondent of the Institution to maintain communication with the parent Institution's headquarters in London.

NORTHERN BRANCH.

Mr. H. C. Tett, B.Sc., D.I.C., A.R.C.S., addressed the Northern Branch on 16th December, 1936, on the subject of "High Performance Fuels."

After explaining the significance of compression ratios in internal-combustion and compression-ignition engines and their relationship to fuel quality, Mr. Tett gave a comprehensive survey of the anti-

knock values of various fuels. The requirements of private cars, racing cars (with and without super-charging) and of different types of aircraft were discussed, and the effects of ethyl blends, alcohol blends, etc., on power output were explained. Mr. Tett concluded by discussing the field of utilisation of 100 octane fuels and the methods and cost of manufacture of such products.

On 20th January, 1937, Mr. J. KEWLEY, M.A., F.I.C., F.C.S., addressed the Branch on "Petroleum in a Changing World."

Following a short historical introduction, Mr. Kewley proceeded to show how the developments in transport had evoked corresponding changes in the technique of the petroleum industry. Fuels of increasingly higher anti-knock value had been obtained by cracking, reforming and polymerization. Similarly, in the field of lubricating oils the demand for oils with flat viscosity curves and anti-oxidation qualities had brought about the development of two completely new processes—hydrogenation and the manufacture of the so-called synthetic lubricants.

BURMA BRANCH.

The Second Annual General Meeting of the Burma Branch was held on 8th January, 1937, at the Volunteer Club, Yenangyaung. The Annual Report and Statement of Accounts was adopted.

The following office-bearers and members of the Committee were elected for the year 1937 :

Chairman : E. Proctor.
Deputy Chairman : J. A. Butlin.
Honorary Secretary : C. E. Keep.

Additional Members of Committee :

T. J. F. Armstrong.
J. L. Benard.
E. J. Bradshaw.
G. A. F. Grindle.
J. B. Meherin.
R. C. Parker.
J. Rankine.

The Annual Report and Accounts of the Burma Branch have been printed and published with the Annual Report of the Council for 1937.

PERSONAL NOTES.

Lieut. J. H. BLAKISTON has left for Holland.
G. DAVIDSON is home on leave.
W. MACKINTOSH GRAY has returned to England.
A. C. GRUNEBERG has left for Iran.
Dr. D. U. JAFAR has left for Iraq.
Dr. H. G. KUGLER is on leave in Switzerland.
D. R. M. PICKARD has left for Iran.
H. T. J. MARTIN is home on leave.
Ing. A. C. TER POORTEN has left for Java.
P. N. D. PORTER has left for Trinidad.
T. A. G. STREDWICK has left for Siam.

The Secretary would be pleased to have the addresses of the following members : H. J. HALLE, I. C. LOW, S. NICOL, M. I. OREVICEANU, and M. L. THOMAS.

INSTITUTION NOTES.

March 1937.

FORTHCOMING MEETINGS.

Tuesday, 4th May, at the Royal Society of Arts, John Street, Adelphi, W.C. 2, commencing at 4.0 p.m. Conference on :

Deep Drilling Problems.

(*a*) **General Report** by Mr. C. A. P. Southwell, M.C., B.Sc., covering the following Papers (*b*) to (*g*)

(*b*) **Geological Aspects of Deep Drilling Problems.** W. E. V. Abraham, B.Sc.

(*c*) **The Preparation and Control of Mud Fluid for Pressure Drilling Conditions.** Dr. J. T. Evans.

(*d*) **Drilling of a Deep Pressure Test in India.** G. F. Wilson, B.Sc.

Papers (*b*), (*c*) and (*d*) have been previously presented to the Burma Branch of the Institution.

(*e*) **Deep Well Drilling.** G. Elias.

Previously presented to the Roumanian Branch.

(*f*) **Deep Drilling in Iran.** C. A. P. Southwell.

(*g*) **A New Type of Thread Connection for Oil Well Casing.** W. M. Frame.

Programme of Meeting.

4.0 to 5.15 p.m.	General Report and Film Exhibition.
5.15 to 6.0 p.m.	Interval.
6.0 to 7.45 p.m.	Discussion.
8.0 p.m.	Informal Dinner.

Overseas Members visiting England at the beginning of May are particularly invited to attend this Conference. Advance copies of the Papers will be available about 15th April.

Tuesday, 8th June, at 6.0 p.m. at The Royal Society of Arts, John Street, Adelphi, W.C. 2, the First Branch Lecture :

Synthesis in the Oil Industry. Dr. G. Egloff.

At a Conference of Branch Chairmen and Secretaries held in London in June 1936, the suggestion was made that an Annual

Lecture be instituted, delivered in the first instance in London and subsequently before the S. Wales and Northern Branches.

The Council is pleased to advise members of the Institution that Dr. Gustav Egloff has accepted its invitation to deliver the first of such lectures. Dr. Egloff will repeat the Lecture on Wednesday, 9th June, at Llandarcy, and on Friday, 11th June, at Manchester.

Sunday, 13th June–Saturday, 21st June. **The 2nd World Petroleum Congress** in Paris.

Members of the Institution may forward their Registration Fee for membership of the 2nd World Petroleum Congress to the Institution offices, Aldine House, Bedford Street, London, W.C. 2.

The registration fee is 10*s*. for a member, and 5*s*. for a member's wife or other relative.

A copy of Circular No. 3 containing details of the Congress programme and post-Congress tours has been forwarded separately to all members of the Institution.

ELECTION OF COUNCIL.

At the Annual General Meeting on 9th March the following retiring members of the Council were re-elected: E. A. Evans, W. E. Gooday, A. C. Hartley, C. A. P. Southwell and A. Beeby Thompson.

Mr. H. C. Tett (new nomination) was also elected a member of the Council.

CANDIDATES FOR ADMISSION.

The following have applied for admission to the Institution, or transfer to another grade of membership, and, in accordance with the By-Laws, the proposals will not be considered until after the lapse of at least one month subsequent to the issue of this Journal, during which any Member or Associate Member may communicate by letter to the Secretary, for the confidential information of the Council, any particulars he may possess respecting the qualifications or suitability of any candidate.

The object of this information is to assist the Council in grading candidates according to the class of membership.

The names of the candidate's proposer and seconder are given in each case, except as provided by By-Laws, Sect. IV. 3.

ANDREWS, John Leslie, Engineer, United British Oilfields of Trinidad, Point Fortin, Trinidad, B.W.I. (*A. Humphries; R. F. Connock.*)

BRAMWYCH, Michael, Geologist (*Trans. from Student*), 40, Alma Square, London, N.W. 8. (*V. C. Illing ; N. M. Brodie.*)

BRIDGWATER, Alan Stuart, Chemical Engineer, Messrs. Foster Wheeler, Ltd., Aldwych House, Aldwych, London, W.C. 2. (*Alfred W. Nash ; L. V. W. Clark.*)

GOW, Douglas, Geologist (*Scottish Development Council*), 6, Leslie Road, Rosyth, Scotland. (*J. H. Blakiston ; W. W. Connor.*)

HOPE, Albert Edward, Chemist (*Shell-Mex & B.P., Ltd.*), 33, Lambton Road, West Wimbledon, London, S.W. 20. (*J. S. Jackson ; F. N. Harrap.*)

MCGHEE, George Crews, Research Student, Queen's College, Oxford. (*A. O. Rankine ; V. C. Illing.*)

MCCULLOCH, Joseph Paul, Geologist, California Standard Oil Co., Ltd., 6, Lothbury, London, E.C. 2. (*C. A. P. Southwell ; A. T. Beazley.*)

MCNAUGHT, Kenneth Robert, Chemist, Shell Co. of Australia, Ltd., North Freemantle, Western Australia. (*T. M. Hartigan ; H. A. Banks.*)

NOTLEY, Guy Tunstall, Engineer (*Sarawak Oilfields, Ltd.*), 411, Coventry Road, Small Heath, Birmingham. (*J. B. Kay ; G. F. Wallis.*)

RAND, Edwin Horace, Sales Manager, Holmes, Mullin & Dunn, Ltd., Donegall House, 7, Howard Street, Belfast. (*J. S. Parker ; D. M. Glendining.*)

RUNDELL, Percy Charles, Chemist (*Frank How & Co., Ltd.*), 24, Fairview Gardens, Woodford Green, Essex. (*S. E. Bowrey ; J. C. Jennings.*)

ARTHUR W. EASTLAKE,
Honorary Secretary.

PERSONAL NOTES.

Dr. P. E. SPIELMANN, Ph.D., F.I.C., represents the Council on the Permanent International Association of Road Congresses.

H. L. ALAN is home from Burma.

R. P. BOLTON has left for Roumania.

A. D. COOPER has gone to Egypt.

G. DICKINSON has left for Venezuela.

J. B. HARRISON has returned from Iran.

J. M. MUIR has left U.S.A. for Australia.

JAMES C. TEMPLETON has returned from the East and will shortly be leaving for South America and the West Indies.

G. WALTER has left Tripoli for Palestine.

P. J. WARD has left for India.

Dr. W. HOPE HENDERSON has left for S. Africa and will be away for three or four months.

The Secretary would be pleased to have the addresses of the following members : I. LUSTY, S. NICOL, M. I. OREVICEANU, K. A. SPEARING and M. L. THOMAS.

NOTICES.

The Institution as a body is not responsible for the statements of opinion expressed in any of its publications.

Copyright.—Publication of abstracts of Papers and articles appearing in the Journal is permitted, provided that acknowledgment is made to the Institution of Petroleum Technologists.

Papers and Articles.—The Council invites Papers and Articles both for reading at Ordinary Meetings of the Institution and for publication in the *Journal*. All Papers, whether for reading or publication, will be submitted to a referee appointed by the Publication Committee.

The Institution has published a brochure "Instructions for the Guidance of Authors" containing details of recommended practice in the preparation of Papers for publication. Copies of this brochure will be supplied on request.

Pre-Prints.—Advance proofs of Papers to be read at Ordinary Meetings are generally available about a week before the Meeting. Members wishing to be supplied with these pre-prints are requested to notify the Secretary.

Abstracts.—Members and Journal Subscribers desirous of receiving the Abstracts printed on one side of the paper only, can be supplied with these at a charge of 10*s*. per annum per copy, payable in advance.

Issue of Journal.—Members whose subscription is not in arrear receive the *Journal* free of cost. A member whose subscription is not paid by March 31st of the year for which it is due is considered to be in arrear.

Changes of Address.—Members are requested to notify any change of address to the Secretary.

Benevolent Fund.—The Benevolent Fund is intended to aid necessitous persons who are or have been members of the Institution, and their dependent relatives.

The Fund is raised by voluntary annual subscriptions, donations, and bequests, and all contributions should be sent to the Secretary of the Institution at Aldine House, Bedford Street, London, W.C. 2. The Fund is administered by the Council through the Benevolent Fund Committee, and all applications in connection therewith must be made on a special form which can be obtained from the Secretary of the Institution.

Appointments Register.—A register of members requiring appointments is kept at the offices of the Institution, and every effort is made to assist members of the Institution in search of employment.

Members who desire their names and qualifications to be included in this register are requested to apply to the Secretary for the Form of Application for Registration, if they have not already done so. Members residing in the London area are asked, if possible, to return this Form in person and make themselves known, together with their requirements, to the Secretary. It is also requested that members should notify the Secretary immediately they have obtained an appointment.

In submitting names of candidates to prospective employers it is understood that the Institution accepts no responsibility and gives no guarantee.

Library.—The Institution's Library may be consulted between the hours of 9.30 a.m. and 5 p.m. daily. (Saturdays, 9.30 a.m. to 12 noon.)

INSTITUTION NOTES.

April 1937.

FORTHCOMING MEETINGS.

Tuesday, 8th June, at 6.0 p.m. at the Royal Society of Arts, John Street, Adelphi, W.C. 2. First Branch Lecture :

" Synthesis in the Oil Industry,"

By Dr. Gustav Egloff.

The Lecture will be followed by an Informal Dinner, of which particulars will be announced later.

Overseas members of the Institution are particularly invited to this function, at which a number of American members will be present who will be attending the 2nd World Petroleum Congress in Paris on 13th–19th June.

Wednesday, 9th June, at Llandarcy. Dr. Egloff will give the First Branch Lecture to the members of the South Wales Branch.

Friday, 11th June, at Manchester. Dr. Egloff will give the First Branch Lecture to the members of the Northern Branch.

Particulars of the meetings at Llandarcy and Manchester respectively are obtainable from the Hon. Secretary of the two Branches, viz :

Mr. E. Thornton, National Oil Refineries, Llandarcy, Glam.
Mr. J. E. Bennion, Sunlight House, Quay Street, Manchester, 3.

Sunday, 13th June–Saturday, 19th June. **The 2nd World Petroleum Congress** in Paris.

Members of the Institution may forward their Registration Fee for membership of the 2nd World Petroleum Congress to the Institution offices, Aldine House, Bedford Street, London W.C. 2.

The registration fee is 10*s*. for a member, and 5*s*. for a member's wife or other relative.

BRANCH CONFERENCE.

The Council has arranged for a Conference of the Chairmen and Secretaries of the Institution's Branch to be held in London on Tuesday, 8th June, to discuss matters relating to the development of the Branches.

ASSISTANT TO THE SECRETARY.

Miss B. M. H. Tripp, B.Sc., has been appointed Assistant to the Secretary.

NEW MEMBERS.

The following elections were made by the Council in accordance with the Bye-Laws, Section IV, para. 7, at the Council Meeting held on the 12th April, 1937.

Elections are subject to confirmation in accordance with the Bye-Laws, Section IV, paras. 9 and 10.

Members.

Brown, William David	London.
Catinari, Juan Norberto	London.
Chalk, Leslie James	London.
Chapman, Alexander Hamilton	London.
Charlton, Henry Ernest	Trieste.
Dodds, Eric	London,
Hughes, Archibald Cecil	Winchester.
Loomis, Albert Geyer	California.
McCarthy, Michael Philips	New Delhi.
Rosaire, Esme Eugene	Houston.
West, Benjamin Williams	Trinidad.

Transfer to Members.

Burgess, Stanley Grove	London.
Lavington, Hugh Vaughan	Trinidad.
Scott, Edwin Cooper	Trinidad.
Templeton, James Clark	London.

Associate Members.

Briggs, Leo Wendel	Brazil.
Bagg, Douglas Gordon	Trinidad.
Cordova, Eric Mortimer	Wirral.
Douglas, Frederic Studdert	Abadan.
Freeman, Harold Arthur	Kirkuk.
West, Harry Longhurst	London.

Transfer to Associate Members.

Fallah, Reza	Abadan.
Hobson, George Douglas	London.
Jafar, Dhya Ul-deen	Baghdad.
Johnson, Norman Malcolm	Masjid-i-Sulaiman.
Mayo, Frank	Fawley.
Poorten, A. C. ter	Java.
Verconk, Gijsbert	Holland.

Students.

Bowring, Frederick Beakbane	Trinidad.
Egg, Russell Armstrong	Sydney.
Rogers, Douglas Charles	London.
Shaw, William George	Trinidad.
Stainforth, Robert Masterman	London.
Wray, Anthony Tom	London.
Wykeham-Martin, Dennis Fiennes	London.

CANDIDATES FOR ADMISSION.

The following have applied for admission to the Institution, or transfer to another grade of membership, and in accordance with the Bye-Laws the proposals will not be considered until after the lapse of at least one month subsequent to the issue of this *Journal*, during which any Member or Associate Member may communicate by letter to the Secretary, for the confidential information of the Council, any particulars he may possess respecting the qualifications or suitability of any candidate.

The object of this information is to assist the Council in grading candidates according to the class of membership.

The names of the candidate's proposer and seconder are given in each case.

BARBOUR, Cyril Claude, Manager (*Texas Oil Co., Manchester*), 10, Victoria Crescent, Eccles, Manchester. (*N. L. Anfilogoff ; W. A. Webster.*)

CLARK, Leslie Vincent Woodhouse, Lecturer (*Birmingham University*), 26, Bodenham Road, Northfield, Birmingham. (*A. W. Nash ; A. E. Dunstan.*) (Trans. from Associate Member.)

CLAUSEN, Justus Friederick, Chemical Engineer, Rysbergsche weg B 65 a, Princenhage, Holland. (*H. I. Waterman ; H. A. van Westen.*) (Trans. from Student.)

COLES, Richard Francis, Clerk (*British Mexican Petroleum Co.*), 37, Eccleston Square, London, S.W. 1. (*W. Kay ; G. W. D'Arcy-Evans.*)

DAVIES, Evan Richard Hywel, Chemist (*I.C.I., Ltd.*), Norton Hall, Norton-on-Tees, Co. Durham. (*K. Gordon ; J. Hughes.*)

EVERETT, Percy Newton, Engineer, Anglo-Iranian Oil Co., Ltd., Britannic House, Finsbury Circus, E.C. 2. (*L. J. Le Mesurier ; F. B. Thole.*)

GILBERT, Cedric Lansdale, Chemist, Asiatic Petroleum Co., Ltd., St. Helen's Court, Great St. Helens, E.C. 3. (*J. Kewley ; W. W. Goulston.*)

HAMILTON, Alex, Engineer (*Irish Shell, Ltd.*), "Oakshaw," Dundrum, Co. Dublin. (*J. A. Halpin ; G. A. Macdonald.*)

HUNTER, Roland Llewellyn, Fields Manager, Trinidad Consolidated Oilfields, Ltd., Fyzabad, Trinidad, B.W.I. (*J. A. Goodwin ; M. A. Ap. Rhys Pryce.*)

JOYCE, John Henry, Chemist (*A.I.D. Kidbrooke*), 13, Hazeldene Drive, Pinner, Middlesex. (*C. W. Tordiffe ; J. S. Jackson.*)

MOSEDALE, Arthur, Refinery Shift Supervisor, Staff Quarters, London & Thames Haven Oil Wharves, Ltd., Stanford-le-Hope, Essex. (*E. Lawson Lomax ; C. E. Evans.*) (Trans. from Student.)

RABINOVITCH, Leo, Consulting Petroleum Technologist, Imperial House, South Street, Moorgate, E.C. 2. (*Harold Moore ; R. B. Hobson.*)

SCHLUMBERGER, Henri Emile Marcel, Geophysicist, Société de Prospection Electrique, 30, rue Fabert, Paris 7e. (*V. C. Illing ; A. O. Rankine.*)

STEVENSON, Harold William, Chemist, Shell Co. of Australia, Ltd., Shell Corner, 153, William Street, Melbourne. (*J. S. Jackson ; F. N. Harrap.*)

THE INSTITUTION OF MECHANICAL ENGINEERS.

GENERAL DISCUSSION ON LUBRICANTS AND LUBRICATION, LONDON, OCTOBER 1937.

The Council of the Institution of Mechanical Engineers with the co-operation of other Technical Institutions * and Societies throughout the world have arranged a General Discussion on Lubrication and Lubricants to be held in London towards the end of October 1937. It is proposed that this discussion should occupy a period of two days and centre round a series of about 100 papers to be invited from leading authorities throughout the world.

It is intended to review the present state of knowledge by means of a general discussion among those especially interested and qualified to discuss the major problems of the subject, with objects such as to endeavour to establish a correlation between theory and practice, to show how bearing design can be applied, to consider the relationships between static and kinetic friction, to balance academic research with trade practice, to classify the views upon bearing metals, and to review the significance of laboratory tests.

* Including the Institution of Petroleum Technologists.

For purposes of convenient discussion, the many aspects of the subject have been arranged under four main Groups, as shown below.

GROUP I. JOURNAL AND THRUST BEARINGS.

Section I. Journal Bearings.

(1) *General.*

(*a*) Theory.
(*b*) Experimental work.
(*c*) Application of results from (*a*) and (*b*) to design.

(2) *Practical Aspects* (covering)

Use of full and partial bearings.
Clearance and fitted bearings.
Central and eccentric loading.
Running-in.
Starting and stopping.
Alignment.
Distortion.
Causes of hot bearings.
Current loads, speeds, clearances, etc.
Temperature rise.
Cleanliness of oil.
High- or low-pressure supply.
Lubricants—mineral, compounded, fatty oils, grease.
Lubricant supply—quantity required, high- and low-pressure supply means, ring oiling, pad and wick lubrication, grooves in bushes, filters, collar oiling.

(3) *Bearing Materials.*

(*a*) Whitemetals (tin-, lead-, cadmium-base metals), bronze, etc., lead bronze.
(*b*) Self-oiling bearings—porous bronze.
(*c*) Special materials :
(i) Lignum vitæ,
(ii) Laminated fabric and resin.
(iii) Rubber.

(4) *Tilting-Pad Journal Bearings.*

(*a*) Michell or Kingsbury type.
(*b*) Nomy type.

Section II. Thrust Bearings.

(1) *Tilting-Pad Type.*

(*a*) Michell or Kingsbury type.
(*b*) Nomy type.

(2) *Collar and Related Types.*

GROUP II. ENGINE LUBRICATION.

Section I. Internal Combustion Engines.

(1) *Cylinder Lubrication.*

(*a*) Régime between the rings and the cylinder wall—fluid or boundary lubrication.
(*b*) Wear of cylinders and piston rings.
(*c*) Oil consumption—influence of ring pressure, ring form, cylinder wear, accuracy of cylinder finish, etc.
(*d*) Lubricants.
(i) Relation of physical and chemical test figures with performance—viscosity, viscosity–temperature curve, oxidation, coking, pour point, moisture, flash point, volatility, etc.
(ii) Type of oil—mineral, fatty, compounded.
(iii) Reclamation of oil and use of reclaimed oil.

(2) *Bearing Lubrication* otherwise than as considered under Section I of Group I.

(*a*) Bearing and crankpin wear.
(*b*) Influence of sludge, moisture, and abraded particles.

(3) *Lubricant Supply.*

(*a*) Pressure, combined pressure, and splash systems.
(*b*) Filters.

INSTITUTION NOTES.

May 1937.

FORTHCOMING MEETINGS.

Tuesday, 8th June, at 6 p.m. at the Royal Society of Arts, John Street, Adelphi, W.C. 2. First Branch Lecture:

"Synthesis in the Oil Industry,"

By Dr. Gustav Egloff.

The Lecture will be followed by an Informal Dinner, of which particulars will be announced later.

Overseas members of the Institution are particularly invited to this function, at which a number of American members will be present who will be attending the 2nd World Petroleum Congress in Paris on 13th–19th June.

Wednesday, 9th June, at 6 p.m. at the Hotel Metropole, Swansea. Dr. Egloff will give the First Branch Lecture to the members of the South Wales Branch.

Friday, 11th June, at 7 p.m. at the Engineer's Club, Albert Square, Manchester. Dr. Egloff will give the First Branch Lecture to the members of the Northern Branch.

2nd World Petroleum Congress 13th–19th June.

Sessions will be held at the Maison de la Chimie, 28 rue Saint-Dominique, Paris.

Sunday, 13th June, at 5 p.m.—Opening Session.

Monday, 14th June to Saturday, 19th June—Technical Sessions. Detailed programme available to Congress members.

Tuesday, 15th June—Official Banquet at Maison de la Chimie—8 p.m.

Wednesday, 17th June—Reception by the Paris Chamber of Commerce, 4 p.m.

Saturday, 19th June—Entertainment and Dinner at Versailles.

Members of the Institution may forward their Registration Fee for membership of the 2nd World Petroleum Congress to the Institution offices, Aldine House, Bedford Street, London, W.C. 2.

The registration fee is 10*s*. for a member and 5*s*. for a member's wife or other relative.

ANNUAL DINNER.

The Annual Dinner of the Institution will be held at the Connaught Rooms, Great Queen Street, London, W.C. 2, on Friday, 8th October, 1937.

CORONATION HONOURS.

H.M. The King has conferred the honour of a Barony of the United Kingdom upon Sir John Cadman, G.C.M.G., D.Sc., D.Litt., D.Eng. (Past-President).

Lt.-Col. H. C. B. Hickling (Member) has received the honour of Commander of the Order of the British Empire.

ARTHUR W. EASTLAKE,
Honorary Secretary.

GENERAL DISCUSSION ON LUBRICATION AND LUBRICANTS.

The Institution of Mechanical Engineers is arranging a General Discussion on Lubrication and Lubricants to be held on 13th to 15th October, 1937. About 100 papers from leading authorities throughout the world will be presented. Particulars of the four main Groups in which the Discussion is arranged, were given in the " Institution Notes " of April.

Tickets of Admission to the Discussion are available free of charge to members of the Institution of Petroleum Technologists. Applications for these tickets should be made to the Secretary, The Institution of Mechanical Engineers, Storey's Gate, London, S.W. 1, from whom can also be obtained a copy of " Circular No. 4 " containing details of papers promised, prices of the volumes of Proceedings, etc.

PERSONAL NOTES.

Mr. C. S. CLEVERLY is home from Iran.

Mr. G. C. F. GREANT has returned from Iraq.

Mr. R. NISBET is home on leave from Assam.

Mr. D. R. M. PICKARD has left for Iraq.

Mr. L. S. B. SIMEON is home from Japan.

Mr. P. H. B. TRASLER has returned from Trinidad.

Mr. G. E. WHEELER is home from Iran.

The Secretary would be pleased to have the addresses of the following members: P. S. KEELING, I. C. LOW, I. LUSTY, A. MACLEAN, H. T. J. MARTIN, J. S. S. MASTERS, S. NICOL, M. I. OREVICEANU, K. A. SPEARING, H. G. SPEARPOINT, M. L. THOMAS and W. W. WATT.

INSTITUTION NOTES.

JUNE 1937.

ADDRESS OF THE INSTITUTION.

A NUMBER of enquiries have been received regarding the postal address of the Institution after June 1937, following the statement made at the Annual General Meeting that the lease of the present premises at Aldine House would expire in June.

The present tenancy has been extended for another year, and the office of the Institution will remain at Aldine House until further notice.

PRESENTATION TO MR. G. SELL.

Subscriptions were invited in January 1937 for a presentation to Mr. George Sell on the occasion of his leaving the staff of the Institution to take up another appointment.

A large number of members took this opportunity of expressing their appreciation of Mr. Sell's valuable work for the Institution during the past 14 years, and at the Institution meeting in London on 8th June, the President, on behalf of the members, presented Mr. Sell with a wireless receiving set and an inscribed silver tankard.

PETROLEUM TECHNOLOGY IN 1936.

The Annual Reviews on the progress of petroleum technology will be published by the Institution about the middle of July as a separate publication. The book will follow an arrangement similar to that of "Petroleum Technology, 1935," which was published last year, and will be available to members of the Institution at reduced rates.

A Prospectus of the book will be circulated to all members and subscribers to the *Journal* within the next few weeks.

FORTHCOMING MEETING.

Northern Branch. A visit has been arranged to take place on Wednesday, 30th June, to the Billingham Plant of Imperial Chemical Industries, Ltd. Full particulars may be obtained from the Honorary Secretary, Northern Branch (Mr. J. E. Bennion, Sunlight House, Quay Street, Manchester).

Annual Dinner. The Annual Dinner of the Institution will be held at the Connaught Rooms, Great Queen Street, on Friday, 8th October, 1937.

NEW MEMBERS.

The following elections were made by the Council in accordance with the By-Laws, Section IV, para. 7, at the Council Meeting held on the 12th April, 1937.

Elections are subject to confirmation in accordance with the By-Laws, Section IV, paras. 9 and 10.

Members

Andrews, John Leslie	Trinidad.
Davies, Evan Richard Hywel	Norton-on-Tees.
Everett, Percy Newton	London.
Gilbert, Cedric Lansdale	London.
Hamilton, Alex	Dublin.
Hope, Albert Edward	London.
Hunter, Roland Llewellyn	Trinidad.
McCulloch, Joseph Paul	London.
Rabinovitch, Leo	London.
Rundell, Percy Charles	Woodford Green.
Schlumberger, Henri Emile Marcel	Paris.
Stevenson, Harold William	Melbourne.

Transfer to Members.

Clark, Leslie Vincent Woodhouse	Birmingham.
Notley, Guy Tunstall	Birmingham.

Associate Members.

Joyce, John Henry	Pinner.
Lawrence, Albert Edward Thomas	Slough.
McGhee, George Crews	Oxford.
McNaught, Kenneth Robert	North Freemantle.
Nabuco, C. E. de Araujo Jor	Rio de Janeiro.
Rand, Edwin Horace	Belfast.

Transfer to Associate Members.

Bridgwater, Alan Stuart	London.
Clausen, Justus Friederich	Princenhage.
Mosedale, Arthur	Stanford-le-Hope.

Student.

Coles, Richard Francis	London.

CANDIDATES FOR ADMISSION.

The following have applied for admission to the Institution or transfer to another grade of membership, and in accordance with the By-Laws the proposals will not be considered until after the lapse of at least one month subsequent to the issue of this *Journal*, during which any Member or Associate Member may communicate by letter to the Secretary, for the confidential information of the Council, any particulars he may possess respecting the qualifications or suitability of any candidate.

The object of this information is to assist the Council in grading candidates according to the class of membership.

The names of the candidate's proposer and seconder are given in each case.

BALLANTYNE, Robert Ewing, Assist. Manager, Marine Dept. (*The Texas Oil Co.*), "Campana," Doran Drive, Redhill, Surrey. (*N. L. Anfilogoff; L. G. M. Roberts.*)

BARNES, Henry Wilfrid, Engineer (*Asbestos & Eng. Products, Ltd.*), Winchester House, Old Broad Street, E.C.2. (*C. Dalley; S. J. M. Auld.*) (*Trans. from Assoc. Mem.*)

BENFORD, Gilbert Arthur, Chemist (*Texas Oil Co.*), 27, Wembley Hill Road, Wembley, Middlesex. (*N. L. Anfilogoff; L. G. M. Roberts.*)

BROWN, Frederick Thomas, Marine Engineer (*Texas Oil Co.*), 20, Victoria Road, Deal, Kent. (*N. L. Anfilogoff; P. H. Raimes.*)

BUCHANAN, Darst Eugene, President, Hanlon-Buchanan, Inc., 718, National Bank of Tulsa Building, Tulsa, Okla. (*C. K. Francis; G. Egloff.*)

DARBYSHIRE, Douglas Hardman, Engineer (*Citex Oil Wharves, Ltd.*), 59, Littlefield Lane, Grimsby, Lincs. (*A. J. Wilson; A. R. Ogston.*)

DELLER, Alan William, Clerk (*Asiatic Petroleum Co., Ltd.*), 38, Mercers Road, Tufnell Park, N.19. (*J. Kewley; W. W. Goulston.*)

GOTHARD, Henry Alexander Sherwin, Consulting Engineer, Holborn Viaduct House, Holborn Viaduct, E.C.1. (*C. F. Evans; R. Lessing.*)

HARGREAVES, Clifford, Engineer, Compania Ferrocarrilera de Petroleo, Kilometro 8, Comodoro Rivadavia, Chubut, Argentina. (*E. R. Senior; G. H. May.*)

HEALEY, Norman, Chemist, 20, Page Hill, Wheatley, Halifax, Yorks. (*J. Kewley; W. W. Goulston.*)

HOWLETT, William Stanley, Production Engineer (*Steaua Romana Co.*), 48, Maryon Road, Charlton, S.E.7. (*C. A. P. Southwell; A. C. Hartley.*)

MUNSTER, Norman Valdemar, Student (*Birmingham University*), 107, Sandford Road, Moseley, Birmingham 13. (*A. W. Nash; L. V. W. Clark.*)

NORRIS, Victor George, Student (*Birmingham University*), 40, Knightlow Road, Harborne, Birmingham 17. (*A. W. Nash; L. V. W. Clark.*)

PRIESTLEY, Samuel Albert Gaston, Chemist (*Shell Co. of Australia*), "Pitsmoor," The Grove, Roseville, N.S.W., Australia. (*D. Fell; H. A. Banks.*) (*Trans. from Student.*)

PYRAH, Alan Frederick, Chemist, c/o Bahrein Petroleum Co., Ltd., P.O. Box 712, Bahrein Island, Persian Gulf. (*A. T. Wilford; J. L. Taylor.*)

SENIOR, Edward Powell, General Manager, Cia Ferrocarrilera de Petroleo, Av. Pres. Roque Saenz Perna 788, Buenos Aires, Argentine. (*P. Roth; A. Rosas.*) (*Trans. from Assoc. Mem.*)

SHELL, George William, Chemist, c/o Shell Co. of Australia, Ltd., Brisbane, Queensland, Australia. (*D. Fell; T. M. Hartigan.*)

SUTHERLAND, Douglas Alexander, Managing Director, Emsco Eng. Co., Ltd., Sandridge Road, St. Albans, Herts. (*N. Matheson; W. J. Wigney.*)

WHEELER, Augustus Edward, Chemist, 31, Langley Way, West Wickham, Kent. (*C. Blake-Smith; J. L. Gregory.*)

ZAVOICO, Basil B., Geologist (*Dept. of Petroleum Economics, The Chase National Bank*), 18, Pine Street, New York, N.Y., U.S.A. (*E. DeGolyer; G. Egloff.*)

ARTHUR W. EASTLAKE,
Honorary Secretary.

GENERAL DISCUSSION ON LUBRICATION AND LUBRICANTS.

The Institution of Mechanical Engineers is arranging a General Discussion on Lubrication and Lubricants to be held on 13th to 15th October, 1937. About 100 papers from leading authorities throughout the world will be presented. Particulars of the four main Groups in which the Discussion is arranged were given in the "Institution Notes" of April.

Tickets of Admission to the Discussion are available free of charge to members of the Institution of Petroleum Technologists. Applications for these tickets should be made to the Secretary, The Institution of Mechanical Engineers, Storey's Gate, London, S.W. 1, from whom can also be obtained a copy of "Circular No. 4" containing details of papers promised, prices of the volumes of Proceedings, etc.

PERSONAL NOTES.

Dr. J. L. HENDERSON is in Canada.

Mr. N. M. JOHNSON is home from Iran.

Mr. A. J. PERKS has returned from Iraq.

Mr. JAMES C. TEMPLETON is home from New York.

Mr. G. F. WALLIS is home on leave from Sarawak.

Mr. J. WESTBURY is returning to Trinidad.

Correspondence or Journals forwarded to the following members have been returned and the Secretary would be pleased to receive any information regarding their present address :—A. G. ENGELBACH, P. S. KEELING, A. P. LIESER, I. C. LOW, I. LUSTY, A. MACLEAN, H. T. J. MARTIN, S. NICOL, M. I. OREVICHANU, K. A. SPEARING, H. G. SPEARPOINT, M. L. THOMAS, B. J. VAVASOUR, W. WALLACE WATT.

INSTITUTION NOTES.

JULY 1937.

ANNUAL DINNER.

THE Annual Dinner of the Institution will be held at the Connaught Rooms, Great Queen Street, Kingsway, London, W.C. 2, on Friday, 8th October, 1937.

HONORARY ASSOCIATE EDITOR.

The Council has appointed Dr. F. H. Garner, Ph.D., M.Sc., F.I.C. (Vice-President), to be Honorary Associate Editor of the Institution's publications.

The Council has also approved the delegation of the editorial work in connection with the *Journal* to a Publication Executive Committee, the members of which are Dr. A. E. Dunstan, Dr. F. H. Garner, Miss B. M. H. Tripp and the Secretary of the Institution.

STUDENTS' MEDAL AND PRIZE.

Papers submitted for the Students' Medal and Prize and for the Students' Prize presented by Mr. T. C. J. Burgess, must be received at the Institution not later than 30th September, 1937.

Particulars of the regulations for both prizes may be obtained from the Secretary.

CANDIDATES FOR ADMISSION.

The following have applied for admission to the Institution or transfer to another grade of membership, and in accordance with the By-Laws the proposals will not be considered until after the lapse of at least one month subsequent to the issue of this *Journal*, during which any Member or Associate Member may communicate by letter to the Secretary, for the confidential information of the Council, any particulars he may possess respecting the qualifications or suitability of any candidate.

The object of this information is to assist the Council in grading candidates according to the class of membership.

The names of the candidate's proposer and seconder are given in each case, except as provided by By-Laws, Sect. IV, para. 3.

CHISHOLM, Roderick Aeneas, Chemist, Anglo-Iranian Oil Co., Ltd., Teheran, Iran. (*A. E. Dunstan ; W. H. Cadman.*) (*Trans. from Student.*)

COX, Reginald Charles Harrie, Manager, Cia. "Itaca" S.A., 25 de Mayo 145, Buenos Aires, Argentina. (*A. E. Dunstan ; G. H. Coxon.*)

DORRELL, Gordon William, Chemist (*Asiatic Petroleum Co., Ltd.*), 41 Queenswood Road, Forest Hill, London, S.E. 23. (*J. Kewley ; J. A. Oriel.*)

GROFF, Jean Louis Eugene, Technical Manager, Société des Raffineries de Petrole de la Gironde, Place Vendome 7, Paris (I), France. (*N. L. Anfilogoff.*)

HAMMERSLEY-HEENAN, Arthur, Student (*Emsco Engineering Co., Ltd.*), 24 Parliament Hill Mansions, Lissenden Gardens, London, N.W. 5. (*F. E. Cherry ; N. Matheson.*)

HUNTER, James Gilchrist, Technical Manager (*British Oil and Turpentine Corpn., Ltd.*), "Monrovia," 85 Cambridge Road, North Harrow, Middlesex. (*W. Kay ; H. W. Chetwin.*)

LAND, Edwin Jacob, Chief Draughtsman (*London & Coastal Oil Wharves, Ltd.*), 8, Grandison Road, Worcester Park, Surrey. (*N. A. Anfilogoff ; L. Nakhimoff.*)

LEVINE, Chaime, Engineer, c/o Shell Company of Egypt, Alexandria, Egypt.

LINCKENHEYL, Georges, Chief Engineer (*Société Anonyme des Petroles Jupiter*), 75 bis, Rue Michel Ange, Paris, France. (*A. Graetz ; R. Godet.*)

MICHELSON, Sol. L., Engineer, c/o Astra Romana S.A.R., Schela Boldesti, Prahova, Roumania. (*I. Braileanu ; G. Prikel.*)

ODAMS, Ronald Charles, Chemist (*Imperial Chemical Industries, Ltd.*), 2, Sutherland Grove, Norton-on-Tees, Co. Durham. (*J. Kewley ; W. W. Goulston.*)

ROE, John Guy Ainsworth, Student (*Birmingham University*), 206, Bristol Road, Birmingham 5. (*A. W. Nash ; L. V. W. Clark.*)

SCIVYER, Arthur William, Chemical Engineer (*Electroflo Meters Co.*), 54, Eastern Road, Romford, Essex. (*W. J. Wilson ; J. F. Taylor.*)

TERRY, John Bascom, Chemist, Standard Oil Company of California, 225, Bush Street, San Francisco, California, U.S.A. (*G. Egloff ; G. H. van Senden.*)

UNDERWOOD, Arthur Joseph Victor, Chemical Engineer, 38, Victoria Street, London, S.W. 1. (*W. R. Ormandy ; F. H. Garner.*)

ARTHUR W. EASTLAKE,
Honorary Secretary.

BRANCH NOTES.

Roumanian Branch.

A well-attended meeting of the Roumanian Branch was held at the Ploesti Chamber of Commerce on Thursday, 27th May. Mr. P. Bogdan read a communication on "Corrosion Problems in Petroleum Refineries."

Dr. Egloff, who delivered the First Branch Lecture in London, Manchester and Swansea in June, also addressed the members of the Roumanian Branch at Ploesti on Monday, 12th July.

The following Programme of Meetings for the remainder of the year has been arranged by the Roumanian Branch Committee :

Thursday, 14th October. "Deep Well Pumping," by E. Boaden, B.Sc.

Thursday, 18th November, "Pressure Maintenance Operations," by P. Lambright, B.S.

Saturday, 11th December. Eleventh Annual Dinner.

DRAFT TENTATIVE METHOD OF ENGINE TEST FOR DIESEL FUELS.

(*I.P.T. Serial Designation—F.O.*39(*T*).)

Supplies of the two Secondary Reference Fuels for use in the above test are now available at the Anglo-Iranian Oil Company's refinery at Llandarcy. These fuels, "H.C.S." and "L.C.S." (*i.e.* "High Cetene Standard" and "Low Cetene Standard" respectively) can be supplied in accordance with the following arrangements:—

Application to:	Anglo-Iranian Oil Company, Ltd., Distribution Department, Britannic House, Finsbury Circus, London, E.C. 2.
Price:	Three shillings per gallon for either grade ex. Llandarcy. Non-returnable packages free.
Freight:	Customer to pay freight.
Packages:	The fuels can be delivered in 40, 10, 4, 2 or 1 gallon containers.

Particulars of the I.P.T. Draft Tentative Method of Engine Test for Diesel Fuels were given on page 774 of Volume 22 (1936) of the *Journal*.

Reprints of the Draft Tentative Method may be obtained gratis upon application to the Secretary, The Institution of Petroleum Technologists, Aldine House, Bedford Street, London, W.C. 2.

WORLD POWER CONFERENCE.

The International Executive Council of the World Power Conference has decided to hold meetings of the Conference during the next five years as under :

August, 1938.—Sectional Meeting in Vienna to discuss " the energy requirements of agriculture, small-scale industry, the household, public lighting and electric railways."

1940.—Second Chemical Engineering Congress in Berlin.

1942.—Fourth Plenary Meeting of the World Power Conference in Tokyo.

INSTITUTION OF MECHANICAL ENGINEERS.

GENERAL DISCUSSION ON LUBRICATION AND LUBRICANTS.

13th to 15th October, 1937.

Particulars of the four main Groups in which the General Discussion on Lubrication and Lubricants is arranged will be found in the " Institution Notes " of April 1937. About 100 papers from leading authorities throughout the world have been promised for presentation, and a selected list of these is given below :

C. H. BARTON (Asiatic Petroleum Company) : Performance of Lubricating Oils in Internal Combustion Engines.

A. BEALE (Streamline Filters) : Reclamation of Oil and Use of Reclaimed Oil.

C. B. DICKSEE (Associated Equipment Company) : Lubrication of the Automobile Engine.

Professor A. C. G. EGERTON (Imperial College of Science and Technology) : Influence of Catalysts in the Gumming of Oils.

A. FOGG and C. JAKEMAN (National Physical Laboratory) : The Influence of Water on the Lubricating Value of a Commercial Motor Oil.

O. T. JONES (Vacuum Oil Company) : Practical Lubrication Problems. Oil Circulating Systems and Oil Performance. Modern Problems in Grease Lubrication. Aircraft Engine Lubrication and the Performance of Solvent-Treated Oils.

E. W. J. MARDLES (Royal Aircraft Establishment, South Farnborough) : Oxidation Behaviour of Internal Combustion Engine Lubricants.

E. A. EVANS (C. C. Wakefield & Company) : Extreme-Pressure Lubrication.

J. E. SOUTHCOMBE and J. H. WELLS (Germ Lubricants, Salford) : An Experimental Study of Lubrication under Conditions of Extreme Pressure.

G. BARR (National Physical Laboratory) : Measurement of the Viscosity of Lubricants at Elevated Temperatures.

E. A. EVANS (C. C. Wakefield & Company) : Metal Soaps in Lubricants.

The complete list of papers is given in " Circular No. 4," obtainable from the Secretary, The Institution of Mechanical Engineers, Storey's Gate, London, S.W. 1, from whom can also be obtained Tickets of Admission to the Discussion (available free of charge to members of the Institution of Petroleum Technologists).

INSTITUTION NOTES.

August 1937.

ANNUAL DINNER.

The Annual Dinner of the Institution will be held at the Connaught Rooms, Great Queen Street, Kingsway, London, W.C. 2, on Friday, 8th October, 1937.

LUBRICANTS AND LUBRICATION.

General Discussion organized by the Institution of Mechanical Engineers.

The Institution of Petroleum Technologists, together with other technical societies and institutions, is co-operating with the Institution of Mechanical Engineers in the organization of a General Discussion on Lubricants and Lubrication to be held in London on 13th–15th October, 1937.

In view of the interest of the subject to members of the Institution of Petroleum Technologists, the first Ordinary Meeting of the 1937–38 Session, which would ordinarily have been held on 12th October, has been postponed until 9th November. It is hoped that members will give their full support to the meetings at the Institution of Mechanical Engineers.

An Exhibition is to be held at the Science Museum, South Kensington, to illustrate the subjects under discussion, and will be devoted to lubricants, bearings, and bearing materials, as well as to testing and other apparatus. The Exhibition will be open for a fortnight from the 13th October.

About 140 papers from leading authorities throughout the world will be presented. The papers are to be arranged in four Groups, and a General Reporters' Summary of the papers in each Group will be prepared, in order to render practicable the adequate discussion of the papers within the limited time available. The subjects of the four Groups and the General Reporters are given below :—

Group I. Journal and Thrust Bearings.
General Reporter : Prof. H. W. Swift, D.Sc., M.A.

Group II. Engine Lubrication.
General Reporters : Mr. Harry Ricardo, F.R.S., and Mr. W. A. Stanier.

Group III. Industrial Applications.
General Reporters : Lt.-Col. S. J. M. Auld, O.B.E., M.C., and Mr. E. A. Evans.

Group IV. Properties and Testing.
General Reporter : Dr. H. J. Gough, M.B.E., F.R.S.

The proposed programme is as follows :—

Wednesday, 13th October.

Afternoon : Opening session and discussion of papers in Group I.

Evening : Opening of Exhibition of Apparatus, and Informal Conversazione.

Thursday, 14th October.

Morning : Discussion of papers in Group II.

Afternoon : Discussion of papers in Group III.

Friday, 15th October.

Morning : Concluding Session. Discussion of papers in Group IV.

Evening : Annual Dinner of Institution of Mechanical Engineers.

The complete Proceedings will be issued as a bound volume. Advance copies of the papers will be available for use at the meetings. The prices of the bound volume and the advance copies are as follows :—

(1) Complete set of advance copies and bound volume of Proceedings at the special reduced rate of £1, if ordered before 28th September, 1937.

(2) Bound volume of Proceedings, if not ordered before 28th September, 1937, at £1 5*s*.

(3) Complete set of advance copies at 8*s*.

(4) Advance copies of the papers in any Group (I, II, III or IV) at 2*s*. 6*d*. per Group.

It is particularly requested that those who desire to attend the Discussion and wish to obtain advance copies of the papers and subscribe for the volume of Proceedings should apply at an early date. Application forms for tickets of admission and for copies of papers may be obtained from the Secretary, the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1.

A list of the papers which have been promised is given below :—

GROUP I. JOURNAL AND THRUST BEARINGS.

E. Baildon (Bradford Technical College) : Performance of Oil Rings.

P. Beuerlein (Hamburg) : The Lubrication of Fabric Bearings.

H. Blok (Royal Dutch Shell, Delft) : Calculation of Local Temperature Rise on Points of Actual Contact under Oiliness Conditions.

R. O. Boswall (Manchester College of Technology) : Characteristics of the 120 deg. Journal Bearing.

Professor Louis J. Bradford and C. G. Vandegrift (Pennsylvania State College) : The Relationship of the Pressure-Viscosity Effect to Bearing Design.

S. A. Brazier and W. Holland-Bowyer (Dunlop Rubber Company) : Rubber as a Material for Bearings.

H. Brillié (Bourg-la-Reine) : Theory of Bearing Technique.

J. P. CHITTENDEN (English Electric Company): Steam Turbine Lubrication Systems and Fire Risk.

D. CLAYTON (National Physical Laboratory): The Effect of Seizure on the Shape of a Crown of the Bush, and the Influence on Subsequent Running.

R. DOWSON (C. A. Parsons and Company): Steam Turbine Thrust Bearings.

G. R. EYSSEN: Structure, Properties, and Performance of Synthetic Resin Bonded Bearing Materials.

E. FALZ (Hanover): General Considerations in the Construction of Journal Bearings.

A. FOGG and S. A. HUNWICKS (National Physical Laboratory): Some Experiments with Water Lubricated Rubber Bearings.

J. HAMILTON GIBSON (Michell Bearings Limited): Pivoted Pad Bearings.

H. L. GUY and D. M. SMITH (Metropolitan-Vickers Electrical Company): Steam Turbine Journal Bearings.

PROFESSOR C. HANOCQ (Liége): Experimental Study of Journal Bearings.

PROFESSOR E. HEIDEBROEK (Dresden): The Nature of Boundary Friction.

S. J. HUNGERFORD (Canadian National Railways): Oils and Lubricants.

C. JAKEMAN and A. FOGG (National Physical Laboratory): The Performance of Complete Clearance Bearings as affected by Load, Speed, Clearance and Lubricant.

G. A. JUHLIN and R. POOLE (Metropolitan-Vickers Electrical Company): End Leakage and Oil Circulation of Ring-Lubricated Bearings.

PROFESSOR G. B. KARELITZ (Columbia University): Oil Supply in Self-Contained Bearings.

PROFESSOR E. A. KRAFT (Allgemeine Elektrizitäts Gesellschaft, Berlin): Thrust Bearings: Theory, Experimental Work and Performance.

F. C. LINN and R. SHEPPARD (General Electric Company, U.S.A.): Thrust Bearings.

S. A. McKEE (U.S. Bureau of Standards, Washington): Journal Bearing Design as Related to Maximum Loads, Speeds and Operating Temperatures.

D. J. MACNAUGHTAN (Tin Research Council): Some Factors that Influence the Service Life of Tin Base Bearing Metals.

AD. MEYER (Brown, Boveri and Company, Baden):

A. G. M. MICHELL (Melbourne): Tilting Pad Bearings.

D. P. C. NEAVE (Copper Development Association): Application of Copper Alloys as Bearing Materials.

S. J. NEEDS (Kingsbury Machine Works, Philadelphia): Influence of Pressure on Viscosity of Oil Film in Bearings.

B. L. NEWKIRK (American Society of Mechanical Engineers): Instability of Oil Films and More Stable Bearings.

PROFESSOR F. K. G. ODQVIST (Royal College of Technology, Stockholm): The Nomy Pad Bearing, Development and Design.

J. FOSTER PETREE: Film Lubrication applied to Railway Axle Bearings.

PROFESSOR L. PRANDTL (Göttingen University): Hydrodynamic Theory.

H. M. RICHARDSON (General Electric Company, U.S.A.): Heavy Duty Bearings of Phenolic Plastics.

H. ROCHESTER (Metropolitan-Vickers Electrical Company): Bakelized Bearings.

H. W. ROWELL (Ellison Insulations): Lubrication of Laminated Synthetic Resinoid Bearing Materials.

C. R. SODERBERG (Westinghouse Electric and Manufacturing Company, Philadelphia): Bearing Problems of Large Steam Turbines and Generators.

A. Sommerfeld (Munich): The Earlier History of the Hydrodynamic Theory of Lubrication Friction.

W. A. Stanier (London, Midland and Scottish Railway): Lubrication as Applied to Locomotive Journals.

Professor H. W. Swift (Sheffield University): Theory and Experiment applied to Journal Bearing Design.

A. S. T. Thomson (Royal Technical College, Glasgow): Film and Friction Measurements on Journal Bearings, including Fabric Types.

E. Watson Smyth (Taylor Brothers, Manchester): Applications of Fabric Bearings.

Professor G. Welter and E. Brasch (Warsaw): Tests of Plain Bearings with a new Method of Lubrication under very High Pressure.

C. G. Williams (Institution of Automobile Engineers): Temperature Rise in Bearings of Automobile Engines and its Influence on Durability.

GROUP II. ENGINE LUBRICATION.

Lt.-Colonel S. J. M. Auld, O.B.E., M.C., and Eng. Lt.-Commander H. J. Nicholson, R.N. (retired) (Vacuum Oil Company): Oil Circulating Systems and Oil Performance.

C. H. Barton (Asiatic Petroleum Company): Performance of Lubricating Oils in Internal Combustion Engines.

E. L. Bass (Asiatic Petroleum Company): Lubrication of Aircraft Engines and Design and Construction.

A. Beale (Stream-Line Filters, Limited): Reclamation of Oil and Use of Reclaimed Oil.

G. D. Boerlage (Royal Dutch Shell, Delft):

C. A. Bouman (Royal Dutch Shell, Delft): Lubrication of Piston Rings.

O. C. Bridgeman (National Bureau of Standards): Automotive Lubrication.

W. S. Burn (Richardsons, Westgarth and Company): Lubrication of Large Internal Combustion Engines.

M. Chatel (French State Railways): Locomotive Cylinder Lubrication.

C. B. Dicksee (Associated Equipment Company): Lubrication of the Automobile Engine.

R. H. Dolton (Alfa-Laval Company, Brentford):

J. Dorpmüller (German State Railways): The Lubrication of Steam Locomotives of the German State Railways.

P. Dumanois (French Air Ministry): Laboratory Test for the Study of the Ageing of Lubricants.

Professor H. A. Everett and G. H. Keller (Pennsylvania State College): Rating Oils for Cylinder Wear by the Iron Contamination Method.

A. E. Flowers (de Laval Separator Company, New York): Service Effects on Lubricating Oils.

A. Fogg and C. Jakeman (National Physical Laboratory): The Influence of Water on the Lubricating Value of a Commercial Motor Oil.

Sterry B. Freeman (Alfred Holt and Company): Marine Engine Lubrication Practice.

T. K. Hanson and Professor A. C. G. Egerton (Imperial College of Science and Technology): Influence of Catalysts on the Oxidation of Oils.

H. Higinbotham (Acheson and Company): Lubrication under High Temperature Conditions with reference to the Use of Colloidal Graphite.

O. T. Jones and E. E. Turner (Vacuum Oil Company): Aero Engine Lubrication and Oil Performance.

E. H. Kadmer (Munich): On the Natural and Artificial Ageing of Automobile Engine Oils.

L. H. de Langen (Philips' Gloeilampenfabrieken, Eindhoven): Application of Magnetic Filters to Lubricating Systems.

E. W. J. Mardles and J. E. Ramsbottom (Royal Aircraft Establishment, Farnboro'): Oxidation Behaviour of Internal Combustion Engine Lubricants.

Professor A. L. Mellanby: Lubrication of Marine Diesel Engines.

V. Mickelsen (Harland and Wolff, Limited): Oil Film Thicknesses and the Lubrication of Internal Combustion Engines.

Eng. Lt.-Commander H. J. Nicholson, R.N. (retired) and D. Whyte (Vacuum Oil Company): Practical Lubrication Problems from the Standpoint of the Mechanical Engineer.

Evert Norlin (Swedish Institute of Testing): Relation between Lubrication and Cylinder Wear in Automobile Engines.

E. C. Ottaway (London Passenger Transport Board): The Problem of Oil Consumption in High-Speed Internal Combustion Engines.

J. E. Pearce (British Cast Iron Research Association): Wear of Cylinder Liners and Piston Rings for Internal Combustion and Steam Engines.

J. A. Pickard (The Metafiltration Company): Filters.

W. A. Stanier (London, Midland and Scottish Railway): Lubricants and Lubrication as applied to Reciprocating Steam Engines.

Alex Taub (Vauxhall Motors, Luton): Engine Lubrication.

Professor C. F. Taylor (Massachusetts Institute of Technology): Cylinder and Bearing Lubrication of High-Speed Internal Combustion Engines.

T. C. Thomsen (T. Kruger and Company, Copenhagen):

Von Philippovich (Deutsche Versuchsanstalt für Luftfahrt):

C. G. Williams (Institution of Automobile Engineers): Oil Viscosity in relation to Cylinder Wear.

Eng.-Comm. A. C. Yeates (D.E.U.A.): The Lubrication of Stationary Oil Engines.

H. J. Young (Sheepbridge Stokes Centrifugal Castings Company): Wear of Cylinders and Piston Rings.

GROUP III. INDUSTRIAL APPLICATIONS.

J. C. Arrowsmith (Pressed Steel Company, Cowley): Lubrication in the Cold Pressing of Sheet Steel.

H. Blok (Royal Dutch Shell, Delft): Surface Temperature Measurements on Gear Teeth under Extreme Pressure Lubricating Conditions.

Professor O. W. Boston (Michigan University): Cutting Fluids.

A. G. Cahill (Hopkinsons, Limited, Huddersfield): Oil Separation.

H. G. Catterall and J. Maitland (Vacuum Oil Company): Modern Problems in Grease Lubrication.

D. Clayton (National Physical Laboratory): The Characteristics of Gear Lubricants revealed by the Four-Ball E.P. Testing Apparatus.

T. W. Cooper (Hoffman Manufacturing Company, Chelmsford): Practical Considerations of Lubrication, etc., in regard to Anti-Friction Bearings.

R. Coulson (Renold and Coventry Chain Company): The Lubrication of Chains with Particular Reference to Chains of the Roller Type.

E. A. Evans (C. C. Wakefield and Company): Extreme-Pressure Lubrication.

S. F. Gimkey (South African Institution of Engineers): Rock Drill Lubrication and Performance.

R. Goodacre (Bruntons, Musselburgh): Lubrication in Wire-drawing.

Professor C. Hanocq (Liége): Experiments on Ball and Roller Bearings.

M. A. Hogan (Safety in Mines Research Board): Lubrication of Colliery Winding and Haulage Ropes.

H. G. King (The British Northrop Loom Co., Blackburn): Lubrication of Textile Spindles.

A. H. Lloyd and H. H. Beeny (Alfred Herbert and Company): Cutting Fluids and Cooling Oils in Machine Tools.

*

O. L. Maag (Timken Roller Bearing Company, Ohio): The Lubrication of Roller Bearings.

H. E. Merritt: The Lubrication of Gear Teeth.

J. F. Miller (Fletcher Miller, Limited, Dukinfield): The Application of Cutting Fluids.

W. G. C. Nixon and W. G. Jackson (S. African Institution of Engineers): Lubrication of Wire Ropes for Hoisting in Mines on the Witwatersrand Gold Fields.

R. J. Parker (George Kent, Limited): Lubrication of Pivots of Light Mechanisms.

C. G. H. Richardson (Ransome and Marles Bearing Company, Limited, Newark): Practical Considerations of the Lubrication of Roller and Needle Roller Bearings.

G. F. Shotter (North Metropolitan Electricity Supply Company): Lubrication in relation to Pivots and Jewels in Electricity Meters.

J. E. Southcombe and J. H. Wells (Germ Lubricants, Salford): An Experimental Study of Lubrication under Conditions of Extreme Pressure.

V. Stott (National Physical Laboratory): Lubrication of Pivot and Jewel Bearings.

Professor A. Tenot (École Nationale des Arts et Metiers, Chalons-sur-Marne): Tests of Bearings: Methods and Results.

Professor F. C. Thompson (University of Manchester): Lubrication in Wire-drawing.

W. A. Tuplin (David Brown and Sons): Gear Lubrication; The Application of Lubricant.

GROUP IV. PROPERTIES AND TESTING.

N. K. Adam: Molecular Forces in Friction and Boundary Lubrication.

W. O. Andrews (S. African Institution of Engineers): Sludge and Deposits in Turbine Oils.

D. P. Barnard (The Standard Oil Company of Indiana): The Effect of Rate of Shear upon Effective Lubricant Viscosity.

G. Barr (National Physical Laboratory): Measurement of the Viscosity of Lubricants at Elevated Temperatures.

F. P. Bowden (Laboratory of Physical Chemistry, Cambridge): Friction of Solid Surfaces.

H. Brillié (Bourg-la-Reine): Influence of Temperature, Oiliness and Surface Condition on the Phenomena of Lubrication.

H. W. Brownsdon (I.C.I. Metals): Some Observations on the Effect of a Number of Added Substances on the Lubricating Properties of Oils.

A. W. Burwell and J. A. Camelford (Alox Corpn., Niagara Falls, N.Y.): Oiliness in relation to Viscosity.

W. E. Campbell (Bell Telephone Laboratories): Moisture Effects on the Coefficient of Static Friction of Lubricated Metal Surfaces.

D. Clayton (National Physical Laboratory): The Behaviour of Various Oils in the Four-Ball Extreme-Pressure Lubricant Testing Apparatus.

Professor H. B. Dorgelo (Technical University, Delft): An Apparatus for Research on Oiliness.

E. A. Evans (C. C. Wakefield and Company): Metal Soaps in Lubricants.

Professor G. I. Finch and F. D. Zahoorbux (Imperial College of Science and Technology): Study of Wear and Lubrication by Electron Diffraction.

A. Fogg (National Physical Laboratory): Measurement of Boundary Friction in an Oscillating Bearing Machine.

J. C. Geniesse (Atlantic Refining Company, Philadelphia): Viscometry as applied to Petroleum Products in the U.S.A.

J. Groff (Raffineries de Pétrole de la Gironde): Graphic Solution of Viscosity and Fluidity Problems.

— Hagemann (Gruppenleiter im Heereswaffenamt): Investigations of Lubricating Oils in Practice.

B. KJERRMAN (S. K. F. Company, Göteborg): The Testing of Ball Bearing Greases.
S. KYROPOULOS (California Institute of Technology): The Problem of Oiliness.
GORDON MCINTYRE (Imperial Oil Company, Ontario):
B. H. MOERBEEK (Royal Dutch-Shell): Oxidation Tests for Motor Oils.
EVERT NORLIN (Swedish Institute of Testing): Swedish Practice regarding the Standardization of Lubricating Oils.
MISS M. E. NOTTAGE (Building Research Station): Static Friction and Boundary Lubrication.
F. SAMUELSON (British Thomson-Houston Company): The Lubrication of Journal Bearings with Water Base Lubricants.
Y. SUGE (The Institute of Physical and Chemical Research, Tokyo): Physical Properties and Lubricants.
PROFESSOR J. J. TRILLAT (Besancon University): The Adsorption of Oils in relation to Lubrication.
J. L. VAN DER MINNE (Amsterdam): Comparison of the Behaviour of various E. P. Lubricants in different Testing Machines.
G. VOGELPOHL (Charlottenburg Technical High School): Thermal Effects on Oiliness in Lubricants.
PAUL WOOG (Cie. Française de Raffinage): Oiliness and Molecular Influences in Lubrication.
— ZORN (I.G. Farbenindustrie A.-G.): The Relation between Chemical Constitution and Properties in Lubricating Oils.

CANDIDATES FOR ADMISSION.

The following have applied for admission to the Institution or transfer to another grade of membership, and in accordance with the Bye-Laws the proposals will not be considered until after the lapse of at least one month subsequent to the issue of this *Journal*, during which any Member or Associate Member may communicate by letter to the Secretary, for the confidential information of the Council, any particulars he may possess respecting the qualifications or suitability of any candidate.

The object of this information is to assist the Council in grading candidates according to the class of membership.

The names of the candidate's proposer and seconder are given in each case.

BRISTOW, Frank Walter, Director (*John English & Co.*), 4, Handel Close, Canons Park, Edgware, Middx. (*C. Blake-Smith ; Walter Kay.*)
FARHI, Ahmad, Student, The University Union, Birmingham. (*A. W. Nash ; L. V. W. Clark.*)
ELDRIDGE, Reginald Alfred, Chemist (*Asiatic Petroleum Co., Ltd.*), St. Helens Court, Great St. Helens, E.C.3. (*J. Kewley ; W. W. Goulston.*)
VON PHILIPPOVICH, Alexander, Research Chemist (*D.V.L.*), Wilhelmsaue, 21, Wilmersdorf, Berlin, Germany. (*F. H. Garner ; F. R. Banks.*)
ROGERS, Harry Samuel, Geologist, c/o North Venezuelan Petroleum Co., Ltd., Apartado 4, Puerto Cabello, Venezuela. (*V. C. Illing ; P. G. H. Boswell.*) (*Trans. from student.*)
SMITH, Joseph Eric, Chemist (*Ransome & Marles Bearing Co.*), Kelham Road, Newark, Notts. (*A. R. Bowen ; E. A. Evans.*)
TITCHMARSH, George Henry, Engineer, c/o Vacuum Oil Co., Pty., Ltd., P.O. Box 2, Wickham, Newcastle, N.S.W., Australia. (*H. B. Borwick ; R. W. Dunster.*)
WILSHERE, Lawrence Arthur, Chemical Engineer, c/o Salermo, Ltd., 14, Waterloo Place, London, S.W.1. (*R. G. Mitchell ; W. H. Cadman.*)

ARTHUR W. EASTLAKE,
Honorary Secretary.

PERSONAL NOTES.

Mr. H. S. GARLICK has left the U.S.A. and is now in England.

Mr. W. E. MADDEN has left for the U.S.A. en route for Mexico.

Mr. F. A. TRIM is in Germany.

Correspondence or Journals forwarded to the following members have been returned, and the Secretary would be pleased to receive any information regarding their present address : A. G. ENGELBACH, P. S. KEELING, A. P. LIESER, I. C. LOW, I. LUSTY, A. MACLEAN, H. T. J. MARTIN, S. NICOL, M. I. OREVICEANU, K. A. SPEARING, H. G. SPEARPOINT, B. J. VAVASOUR, and W. WALLACE WATT.

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INSTITUTION NOTES.

SEPTEMBER 1937.

1937–1938 SESSION.

Friday, 8th October. **Annual Dinner,** at the Connaught Rooms, Great Queen Street, Kingsway, London, W.C.2, at 7.0 for 7.30 p.m. Tickets 12*s.* 6*d.* each, exclusive of wines. Students Tickets 7*s.* 6*d.* Application for tickets should be made as early as possible.

Wednesday, 13th October to Friday, 15th October. **Discussion on Lubricants and Lubrication,** organized by the Institution of Mechanical Engineers.

Wednesday, 13th October.

9.30 a.m.: Secretary's Office opens for Registration, distribution of badges, etc.

2.30 p.m.: Opening Session and discussion of papers in Group I.

8.30 p.m.: Opening of Exhibition of Apparatus, and Informal Conversazione.

Thursday, 14th October.

10.0 a.m.: Discussion of papers in Group II.

2.30 p.m.: Discussion of papers in Group III.

Friday, 15th October.

10.0 a.m.: Concluding Session. Discussion of papers in Group IV.

The meetings will be held at the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1. The Exhibition of Apparatus and Informal Conversazione will be held at the Science Museum, South Kensington, S.W.7.

A list of the Papers which have been promised was given in the Institution Notes of August 1937.

Tuesday, 9th November, at the Royal Society of Arts, John Street, Adelphi, W.C.2, at 5.30 p.m.

Discussion on De-Waxing.

(1) "**The Principles of Solvent De-waxing. Part II: Equilibria and Computations for Double Solvent Systems,**" by M. Ba Thi, T. G. Hunter and A. W. Nash.

(2) "**The Effect of Small Amounts of Various Substances on the Crystallization of Wax from an Oil Medium,**" by E. C. H. Kolvoort, F. H. Moser and C. G. Verver.

(3) "**The Development of the Separator-Nobel Heavy Solvent Centrifugal De-waxing Process,**" by N. O. Backlund and B. K. Engel.

General Reporter: T. G. Hunter, M.Sc.

Tuesday, 14th December, at the Royal Society of Arts, John Street, Adelphi, W.C.2, at 5.30 p.m.

"**The Microscopical Examination of Crude Petroleum,**" by J. McConnell Sanders, F.I.C., F.C.S.

(*This paper is given in full on pp. 525–573 of the present Journal.*)

NORTHERN BRANCH.

Wednesday, 20th October. "**The Value of Road Testing in Petroleum Research,**" by L. G. Callingham, M.I.A.E., F.I.M.T.

Wednesday, 17th November. **"The Modern Aero-Engine and its Fuels,"** by E. L. Bass.

Friday, 3rd December. Joint Meeting with the Society of Chemical Industry. **"Developments in the Petroleum Industry,"** by Dr. A. E. Dunstan, D.Sc., F.I.C. Illustrated by cinematograph film.

Wednesday, 15th December. **"Asphalt for Road Making,"** by Dr. F. H. Garner, Ph.D., M.Sc., F.I.C.

ROUMANIAN BRANCH.

Thursday, 14th October. 58th General Meeting. **"Deep Well Pumping,"** by E. Boaden, B.Sc.

Thursday, 18th November. 59th General Meeting. **"Pressure Maintenance Operations,"** by P. Lambright, B.S.

Saturday, 11th December. **11th Annual Dinner.**

STUDENTS' SECTION (LONDON BRANCH).

Thursday, 7th October. Paper by Dr. A. E. Dunstan.

Tuesday, 26th October. Visit to Battersea Power Station.

Wednesday, 10th November. Paper by W. R. Wright (Student).

Tuesday, 23rd November. Annual Open Meeting. Address by Lt.-Col. S. J. M. Auld (President).

Thursday, 9th December. Joint Meeting with Graduate Section of the Institution of Automobile Engineers and Students' Section of Royal Aeronautical Society.

Tuesday, 21st December. Paper by N. E. F. Hitchcock (Student).

CANDIDATES FOR ADMISSION.

The following have applied for admission to the Institution or transfer to another grade of membership, and in accordance with the By-Laws the proposals will not be considered until after the lapse of at least one month subsequent to the issue of this Journal, during which any Member or Associate Member may communicate by letter to the Secretary, for the confidential information of the Council, any particulars he may possess respecting the qualifications or suitability of any candidate.

The object of this information is to assist the Council in grading candidates according to the class of membership.

The names of the candidate's proposer and seconder are given in each case.

LEWIS-ROBERTS, Arthur Lionel, Engineer, c/o The Texas Company (South Africa) Ltd., P.O. Box 1061, Nairobi, Kenya, East Africa. (*N. L. Anfilogoff; P. H. Raimes.*)

MASON, Mervyn, Chemist (*Matthew Wells & Co., Ltd., Manchester*), 56, Garswood Road, Fallowfield, Manchester, 14. (*James Barrett; J. E. Haslam.*)

WRIGHT, William Morley, Surveyor, c/o Messrs. Carmichael & Clarke, Bank of East Asia Building, Hong Kong. (*T. H. G. Brayfield; A. W. Black.*)

NOMINATIONS FOR COUNCIL.

Nomination Papers for candidates for election to the Council must be delivered to the Secretary of the Institution not later than Tuesday, 30th November.

Every Member and Associate Member of the Institution may send in writing to the Council the name of a Member whom he desires to recommend for election to the Council. This nomination must be signed by at least nine other Members or Associate Members. No Member or Associate Member may sign more than one Nomination Paper in any one year. (By-Laws Sect. VIII. 5.)

Nomination Forms are kept at the Institution office for the convenience of Members and will be supplied on request by the Secretary. It is not, however, necessary that these Forms be used. Any nomination which complies with the requirements given above will be considered valid.

ARTHUR W. EASTLAKE,
Honorary Secretary.

PERSONAL NOTES.

Prof. C. H. WEISS has been nominated Chevalier of the Légion d'Honneur.

Dr. A. O. RANKINE has left the Imperial College and is now Chief Physicist to Anglo-Iranian Oil Co.

J. T. GUTHRIE has left Iran for Edinburgh.

E. M. HOLBROOK has left London for Canada.

M. KAMEN KAYE has left Venezuela for New York.

G. J. MALHERBE has come to London from New York.

Correspondence or Journals forwarded to the following members have been returned, and the Secretary would be pleased to receive any information regarding their present address : A. G. ENGELBACH, S. M. HANNAN, P. S. KEELING, A. P. LIESER, I. C. LOW, I. LUSTY, A. MACLEAN, H. T. J. MARTIN, S. NICOL, M. I. OREVICEANU, K. A. SPEARING, H. G. SPEARPOINT, B. J. VAVASOUR, W. WALLACE WATT.

NOTICES.

The Institution as a body is not responsible for the statements of opinion expressed in any of its publications.

Copyright.—Publication of abstracts of Papers and articles appearing in the Journal is permitted, provided that acknowledgment is made to the Institution of Petroleum Technologists.

Papers and Articles.—The Council invites Papers and Articles both for reading at Ordinary Meetings of the Institution and for publication in the *Journal*. All Papers, whether for reading or publication, will be submitted to a referee appointed by the Publication Committee.

The Institution has published a brochure "Instructions for the Guidance of Authors" containing details of recommended practice in the preparation of Papers for publication. Copies of this brochure will be supplied on request.

Pre-Prints.—Advance proofs of Papers to be read at Ordinary Meetings are generally available about a week before the Meeting. Members wishing to be supplied with these pre-prints are requested to notify the Secretary.

Abstracts.—Members and Journal Subscribers desirous of receiving the Abstracts printed on one side of the paper only, can be supplied with these at a charge of 10*s*. per annum per copy, payable in advance.

Issue of Journal.—Members whose subscription is not in arrear receive the *Journal* free of cost. A member whose subscription is not paid by March 31st of the year for which it is due is considered to be in arrear.

Changes of Address.—Members are requested to notify any change of address to the Secretary.

Benevolent Fund.—The Benevolent Fund is intended to aid necessitous persons who are or have been members of the Institution, and their dependent relatives.

The Fund is raised by voluntary annual subscriptions, donations, and bequests, and all contributions should be sent to the Secretary of the Institution at Aldine House, Bedford Street, London, W.C. 2. The Fund is administered by the Council through the Benevolent Fund Committee, and all applications in connection therewith must be made on a special form which can be obtained from the Secretary of the Institution.

Appointments Register.—A register of members requiring appointments is kept at the offices of the Institution, and every effort is made to assist members of the Institution in search of employment.

Members who desire their names and qualifications to be included in this register are requested to apply to the Secretary for the Form of Application for Registration, if they have not already done so. Members residing in the London area are asked, if possible, to return this Form in person and make themselves known, together with their requirements, to the Secretary. It is also requested that members should notify the Secretary immediately they have obtained an appointment.

In submitting names of candidates to prospective employers it is understood that the Institution accepts no responsibility and gives no guarantee.

Library.—The Institution's Library may be consulted between the hours of 9.30 a.m. and 5 p.m. daily. (Saturdays, 9.30 a.m. to 12 noon.)

INSTITUTION NOTES.

October 1937.

1937–1938 SESSION.

Tuesday, 9th November, at the Royal Society of Arts, John Street, Adelphi W.C.2, at 5.30 p.m.

Discussion on De-Waxing.

(1) "**The Principles of Solvent De-waxing. Part II: Equilibria and Computations for Double Solvent Systems,**" by M. Ba Thi, T. G. Hunter and A. W. Nash.

(2) "**The Effect of Small Amounts of Various Substances on the Crystallization of Wax from an Oil Medium,**" by E. C. H. Kolvoort, F. H. Moser and C. G. Verver.

(3) "**The Development of the Separator-Nobel Heavy Solvent Centrifugal De-waxing Process,**" by N. O. Backlund and B. K. Engel.

General Reporter: T. G. Hunter, M.Sc.

Tuesday, 14th December, at the Royal Society of Arts, John Street, Adelphi, W.C.2, at 5.30 p.m.

"**The Microscopical Examination of Crude Petroleum,**" by J. McConnell Sanders, F.I.C., F.C.S.

(*This paper was given in full on pp. 525–573 of the September 1937 Journal.*)

NORTHERN BRANCH.

Wednesday, 17th November. "**The Modern Aero-Engine and its Fuels,**" by E. L. Bass.

Friday, 3rd December. Joint Meeting with the Society of Chemical Industry. "**Developments in the Petroleum Industry,**" by Dr. A. E. Dunstan, D.Sc., F.I.C. Illustrated by cinematograph film.

Wednesday, 15th December. "**Asphalt for Road Making,**" by Dr. F. H. Garner, Ph.D., M.Sc., F.I.C.

ROUMANIAN BRANCH.

Thursday, 18th November. 59th General Meeting. "**Pressure Maintenance Operations,**" by P. Lambright, B.S.

Saturday, 11th December. **11th Annual Dinner.**

STUDENTS' SECTION (LONDON BRANCH).

Wednesday, 10th November. Paper by W. R. Wright (Student).

Tuesday, 23rd November. Annual Open Meeting. Address by Lt.-Col. S. J. M. Auld (President).

Thursday, 9th December. Joint Meeting with Graduate Section of the Institution of Automobile Engineers and Students' Section of Royal Aeronautical Society.

Tuesday, 21st December. Paper by N. E. F. Hitchcock (Student).

NEW MEMBERS.

The following elections were made by Council in accordance with the By-Laws, Section IV, para. 7, at the Council Meeting held on the 12th October, 1937.

Elections are subject to confirmation in accordance with the By-Laws, Section IV, paras. 9 and 10.

Members.

Ballantyne, Robert Ewing	Redhill.
Buchanan, Darst Eugene	Oklahoma.
Cox, Reginald Charles Harrie	Argentine.
Dorrell, Gordon William	London.
Gothard, Henry Alexander Sherwin	London.
Groff, Jean Louis Eugene	Paris.
Hargreaves, Clifford	Argentine.
Howlett, William Stanley	London.
Hunter, James Gilchrist	Harrow.
Linckenheyl, Georges	Paris.
Odams, Ronald Charles	Durham.
Shell, George William	Australia.
Sutherland, Douglas Alexander	St. Albans.
Terry, John Bascom	California.
Underwood, Arthur Joseph	London.

As transfer to Member.

Barnes, Henry Wilfrid	London.
Senior, Edward Powell	Argentine.
Zavoico, Basil B.	New York.

Associate Members.

Barbour, Cyril Claude	Manchester.
Brown, Frederick Thomas	London.
Darbyshire, Douglas Hardman	Grimsby.
Land, Edwin Jacob	London.
Michelson, Sol. L.	Roumania.
Pyrah, Alan Frederick	Iran.
Scivyer, Arthur William	Romford.
Wheeler, Augustus Edward	London.

Transfer to Associate Members.

Chisholm, Roderick Aeneas	Iran.
Priestley, Samuel Albert Gaston	Australia.

Students.

Deller, Alan William	London.
Hammersley-Heenan, Arthur	London.
Healey, Norman	Halifax.
Munster, Norman Valdemar	Birmingham.
Norris, Victor George	Birmingham.

Associates.

Benford, Gilbert Arthur	London.

As transfer to Associates.

Bramwych, Michael	London.
Roe, John Guy Ainsworth	Birmingham.

AWARD OF SCHOLARSHIPS.

The Council has awarded the two Institution Scholarships of £40 per annum to the following Students:

G. E. HIGGINS, tenable at the Royal School of Mines, Imperial College of Science and Technology.

V. G. NORRIS, tenable at the University of Birmingham.

NOMINATIONS FOR COUNCIL.

Nomination Papers for candidates for election to the Council must be delivered to the Secretary of the Institution not later than Tuesday, 30th November.

Every Member and Associate Member of the Institution may send in writing to the Council the name of a Member whom he desires to recommend for election to the Council. This nomination must be signed by at least nine other Members or Associate Members. No Member or Associate Member may sign more than one Nomination Paper in any one year. (By-Laws Sect. VIII. 5.)

Nomination Forms are kept at the Institution office for the convenience of Members and will be supplied on request by the Secretary. It is not, however, necessary that these Forms be used. Any nomination which complies with the requirements given above will be considered valid.

ARTHUR W. EASTLAKE,
Honorary Secretary.

PERSONAL NOTES.

Mr. J. CATINARI has left for the U.S.A.

Mr. P. EVANS has returned to Assam.

Mr. D. N. MCKINLAY is in Iran.

Mr. C. A. MOON has left Trinidad and is now in Germany.

Mr. A. J. PERKS has returned to Iraq.

Mr. E. T. VACHELL has left for Assam.

Correspondence or Journals forwarded to the following members have been returned, and the Secretary would be pleased to receive any information regarding their present address: A. G. ENGELBACH, S. M. HANNAN, P. S. KEELING, A. P. LIESER, I. C. LOW, I. LUSTY, A. MACLEAN, H. T. J. MARTIN, Mrs. B. E. MIELNIKOWA, S. NICOL, M. I. OREVICEANU, K. A. SPEARING, H. G. SPEARPOINT, W. WALLACE WATT.

*

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Copyright.—Publication of abstracts of Papers and articles appearing in the Journal is permitted, provided that acknowledgment is made to the Institution of Petroleum Technologists.

Papers and Articles.—The Council invites Papers and Articles both for reading at Ordinary Meetings of the Institution and for publication in the *Journal*. All Papers, whether for reading or publication, will be submitted to a referee appointed by the Publication Committee.

The Institution has published a brochure "Instructions for the Guidance of Authors" containing details of recommended practice in the preparation of Papers for publication. Copies of this brochure will be supplied on request.

Pre-Prints.—Advance proofs of Papers to be read at Ordinary Meetings are generally available about a week before the Meeting. Members wishing to be supplied with these pre-prints are requested to notify the Secretary.

Abstracts.—Members and Journal Subscribers desirous of receiving the Abstracts printed on one side of the paper only, can be supplied with these at a charge of 10*s*. per annum per copy, payable in advance.

Issue of Journal.—Members whose subscription is not in arrear receive the *Journal* free of cost. A member whose subscription is not paid by March 31st of the year for which it is due is considered to be in arrear.

Changes of Address.—Members are requested to notify any change of address to the Secretary.

Benevolent Fund.—The Benevolent Fund is intended to aid necessitous persons who are or have been members of the Institution, and their dependent relatives.

The Fund is raised by voluntary annual subscriptions, donations, and bequests, and all contributions should be sent to the Secretary of the Institution at Aldine House, Bedford Street, London, W.C. 2. The Fund is administered by the Council through the Benevolent Fund Committee, and all applications in connection therewith must be made on a special form which can be obtained from the Secretary of the Institution.

Appointments Register.—A register of members requiring appointments is kept at the offices of the Institution, and every effort is made to assist members of the Institution in search of employment.

Members who desire their names and qualifications to be included in this register are requested to apply to the Secretary for the Form of Application for Registration, if they have not already done so. Members residing in the London area are asked, if possible, to return this Form in person and make themselves known, together with their requirements, to the Secretary. It is also requested that members should notify the Secretary immediately they have obtained an appointment.

In submitting names of candidates to prospective employers it is understood that the Institution accepts no responsibility and gives no guarantee.

Library.—The Institution's Library may be consulted between the hours of 9.30 a.m. and 5 p.m. daily. (Saturdays, 9.30 a.m. to 12 noon.)

INSTITUTION NOTES.

NOVEMBER 1937.

1937–1938 SESSION.

Thursday, 16th December, at the Royal Society of Arts, John Street, Adelphi, W.C.2, at 5.30 p.m.

"The Microscopical Examination of Crude Petroleum," by J. McConnell Sanders, F.I.C., F.C.S.

(*This paper was given in full on pp. 525–573 of the September* 1937 *Journal.*)

Please note alteration of date.

Tuesday, 11th January, 1938, at the Royal Society of Arts, John Street, Adelphi, W.C.2, at 5.30 p.m.

"Metering and Automatic Control."

Particulars of this Meeting will be announced later.

NORTHERN BRANCH.

Friday, 3rd December. Joint Meeting with the Society of Chemical Industry. **"Developments in the Petroleum Industry,"** by Dr. A. E. Dunstan, D.Sc., F.I.C. Illustrated by cinematograph film.

Wednesday, 15th December. **"Asphalt for Road Making,"** by Dr. F. H. Garner, Ph.D., M.Sc., F.I.C.

ROUMANIAN BRANCH.

Saturday, 11th December. **11th Annual Dinner.**

STUDENTS' SECTION (LONDON BRANCH).

Thursday, 9th December. Joint Meeting with Graduate Section of the Institution of Automobile Engineers and Students' Section of Royal Aeronautical Society.

Tuesday, 21st December. Paper by N. E. F. Hitchcock (Student).

CONFERENCE ON SHALES AND CANNEL COALS.

GLASGOW, JUNE 1938.

A separate Circular is being issued to all members of the Institution containing a preliminary announcement of a Conference on Shales and Cannel Coals to be held in Glasgow from 6th June (Whit Monday) to 11th June, 1938.

This Conference is being organized by the Council with the collaboration of an Organizing Committee in Scotland. Membership of the Conference is open to all members of the Institution, and also to the members of twelve other technical societies and institutions in Great Britain and Europe.

The Conference has received the patronage of Ministers of H.M. Government and the support of the organizers of the Empire Exhibition which is to be held in Glasgow from May to October 1938. It has also received the support of representatives of civic

and educational authorities, scientific and technical societies and of the petroleum, shale, coal-mining, gas and chemical industries.

In the Preliminary Circular the importance of early Registration is emphasized. The object of this is to facilitate the work of the Organizing Committee, particularly as regards the reservation of hotel accommodation. It is anticipated that there will be very heavy demands on hotel accommodation in Glasgow during June 1938. The Council invites the co-operation of members of the Institution in this matter of forwarding to the Secretary an early notification of their intention to be present.

RESEARCH FUND.

The Council has approved a grant up to £100 from the Institution's Research Fund to Dr. G. M. Dyson, B.A., Ph.D., F.I.C., M.Inst.P.T., of the Technical College, Loughborough.

The subject of Dr. Dyson's research is the effect of bearing metal detritus on the oxidation of lubricating oils.

HONORARY MEMBERS.

The Council has conferred Honorary Membership of the Institution upon :—

Sir William Bragg, O.M., K.B.E., LL.D., D.Sc., F.R.S., during the tenure of his office as Director of the Davy-Faraday Research Laboratory, The Royal Institution.

Sir Henry T. Tizard, K.C.B., M.A., F.R.S., during the tenure of his office as Rector of the Imperial College of Science and Technology.

STUDENTS' PRIZE AWARDS.

Mr. Alfred H. Nissan, B.Sc., Stud.Inst.P.T. (Birmingham University), has been awarded the Students Medal and a Prize of £5 for a thesis on :—" An Investigation into the cost of Oil Absorption Plant for Natural Gasoline Recovery at High Pressure and Low Temperature."

Mr. E. N. Tiratsoo, Stud.Inst.P.T. (Royal School of Mines) has been awarded a Prize of £5 for a thesis on :—" The Radioactive Factor in the Genesis and Constitution of Hydrocarbons."

WORLD PETROLEUM CONGRESS.

The Permanent Council of World Petroleum Congresses (President : Col. L. Pineau) has appointed the Secretary of the Institution of Petroleum Technologists as Secretary of the Permanent Council.

NOMINATIONS FOR COUNCIL.

Nomination Papers for candidates for election to the Council must be delivered to the Secretary of the Institution not later than Tuesday, 30th November.

Every Member and Associate Member of the Institution may send in writing to the Council the name of a Member whom he desires to recommend for election to the Council. This nomination must be signed by at least nine other Members or Associate Members. No Member or Associate Member may sign more than one Nomination Paper in any one year. (By-Laws Sect. VIII. 5.)

Nomination Forms are kept at the Institution office for the convenience of Members and will be supplied on request by the Secretary. It is not, however, necessary that these Forms be used. Any nomination which complies with the requirements given above will be considered valid.

NEW MEMBERS.

The following elections were made by Council in accordance with the By-Laws, Section IV, para. 7, at the Council Meeting held on the 9th November, 1937.

Elections are subject to confirmation in accordance with the By-Laws, Section IV, paras. 9 and 10.

Members.

ELDRIDGE, Reginald Alfred	London.
PHILIPPOVICH, Alexander von	Berlin.
TITCHMARSH, George Henry	Australia.
WILSHERE, Lawrence Arthur	London.

Associate Members.

BRISTOW, Frank Walter	Edgware.
ROBERTS, Arthur Lionel Lewis	East Africa.
MASON, Mervyn	Manchester.
SMITH, Joseph Eric	Newark.
WRIGHT, William Morley	Hong Kong.

As transfer to Associate Members.

ROGERS, Harry Samuel	Venezuela.

Student.

FARHI, Ahmad	Birmingham.

CANDIDATES FOR ADMISSION.

The following have applied for admission to the Institution or transfer to another grade of membership, and in accordance with the By-Laws the proposals will not be considered until after the lapse of at least one month subsequent to the issue of this Journal, during which any Member or Associate Member may communicate by letter to the Secretary, for the confidential information of the Council, any particulars he may possess respecting the qualifications or suitability of any candidate.

The object of this information is to assist the Council in grading candidates according to the class of membership.

The names of the candidate's proposer and seconder are given in each case.

BERTENSHAW, Stanley Weaver, Engineer (*Shell-Mex & B.P., Ltd., Leeds*), 2, Norman Terrace, Street Lane, Roundhay, Leeds, 8. (*P. N. Everett; P. H. Herring.*)

BURSLEM, John, Driller, c/o Apex (Trinidad) Oilfields, Ltd., Siparia P.O., Trinidad, B.W.I. (*G. H. Scott; A. H. Richard.*)

CHALMER, Stanley O., Engineer, c/o Commonwealth Oil Refineries, Ltd., 90, William Street, Melbourne, C.1, Australia. (*G. F. M. McKillop; E. W. Sheel.*)

COX, Frederick James, Manager (*Ebor Petroleum Co., Ltd., Huddersfield*), 22, Ullswater Road, Blackpool, S.S. (*Harold Moore; R. B. Hobson.*)

DAVIES, Thomas Trevor, Student (*Shell Central Laboratories*), 77, Sunnyside Road, London, N.19. (*J. S. Jackson; J. Parrish.*)

DE FREITAS, Henry Anselm, Student, West Indian Club, 4, Whitehall Court, London, S.W.1. (*V. C. Illing.*)

EVERIST, Geoffrey Edward, Assistant Chemist (*Shell Central Laboratories*), 67, Kidderminster Road, Croydon, Surrey. (*J. S. Jackson; J. Parrish.*)

GOODFELLOW, Alfred John, Chemist (*Carless, Capel & Leonard*), 117, Roslyn Road, S. Tottenham, N.15. (*F. Barrow; J. M. Leonard.*)

HARDIMAN, Eric W., Chemist (*Anglo-American Oil Co.*), 8, Grosvenor Road, Finchley, N.3. (*F. H. Garner; A. Osborn.*)

HEISCH, Godfrey Edward, Student, "Maybury," Collington Lane, Bexhill-on-Sea, Sussex. (*V. C. Illing.*)

HINTON, Cedric Alan, Engineer (*Anglo-Iranian Oil Co., Ltd.*), 2, Ladbroke Square, London, W.11. (*A. C. Hartley; A. E. Dunstan.*)

HOYTE, William Norman, Chemical Engineer (*The Distillers Co., Ltd.*), Pembury Frith, Pembury, Kent. (*Cecil W. Wood; K. Washington Gray.*)

JACKSON, James, Chemist, c/o Sarawak Oilfields, Ltd., Miri, Sarawak (Stud. 1934). (*A. T. S. Simpson; J. B. Kay.*)

KANE, John, Chemist (*Shell Central Laboratories*), 6, Wallace Road, Canonbury, London, N.1. (*J. S. Jackson; J. Parrish.*)

MASKELL, Laurence Ormes, Chemist (*Silvertown Lubricants, Ltd.*), 40, Maury Road, Stoke Newington, N.16. (*E. R. Styles; Wm. Lee.*)

MCGINTY, James, Student, Royal School of Mines, London, S.W.7. (*P. G. H. Boswell; V. C. Illing.*)

MILLER, John Thomas Veness, Manager (*Anglo-Saxon Petroleum Co.*), 2, Sidmouth Road, London, N.W.2. (*J. McConnell Sanders; A. H. Howard.*)

MILLER, Thomas Albert, Mech. Engineer, Bapco Refinery, Bahrein Island, Persian Gulf. (*S. J. M. Auld; H. W. Barnes.*)

PEUTHERER, Willison Bryce, Chemist (*Scottish Oils, Ltd.*), Cawburn, Pumpherston, Midlothian. (*R. Crichton; A. E. Dunstan.*)

SHAW, Ralph, Chemical Engineer (*Wailes Dove Bitumastic, Ltd.*), Harewood, Low Fell, Gateshead. (*H. S. Milner; L. J. Chalk.*)

SMITH, George Henderson, Chemist (*Scottish Oils, Ltd.*), 2, Westhall Gardens, Uphall, Westlothian. (*R. Crichton; A. E. Dunstan.*)

SMOLEY, Eugene Ralph, Chem. Engineer (*The Lummus Co., New York City*), 420, Lexington Avenue, New York, N.Y. (*E. R. Lederer; A. E. Miller.*)

TAVANA, J., Student, 37, Emperor's Gate, London, S.W.7. (*V. C. Illing.*)

THEMOIN, Henry F., Purchasing Manager (*Standard Francaise des Petroles, Paris*), 2, rue d'Alsace, Asnieres Seine, France. (*Lord Cadman; A. E. Dunstan.*)

WARDROP, Ian Dalglish, Superintendent (*London & Thames Haven Oil Wharves, Ltd.*), 83, Highlands Boulevard, Leigh-on-Sea, Essex. (*N. L. Anfilogoff; R. F. Hurt.*)

ARTHUR W. EASTLAKE,
Honorary Secretary.

PERSONAL NOTES.

Mr. R. E. ADLINGTON has returned from Iran.

Mr. J. S. MEREDITH is home from Roumania.

Mr. A. REID is in Iraq.

Mr. R. K. VAN SICKLE is in Austria.

Correspondence or Journals forwarded to the following members has been returned, and the Secretary would be pleased to receive any information regarding their present address: A. G. ENGELBACH, R. HARMAN, A. D. JONES, J. LANDER, A. P. LIESER, I. C. LOW, I. LUSTY, A. MACLEAN, S. NICOL, M. I. OREVICEANU, E. B. SANGSTER, F. J. SCHNEIDER, and H. G. SPEARPOINT.

BINDING OF VOL. 23 (1937).

Orders for binding Vol. 23 of the Journal may be forwarded to: Richard Clay & Sons, Ltd., Blackfriars House, New Bridge Street, London, E.C.4, and should be accompanied by the separate parts and appropriate remittance.

Bindings are available in two styles:—

Style A.—Light green cloth, lettered gold

Cost of Binding Case - - - -	1s. 0d.
Cost of Binding and Postage - - -	6s. 0d.
	7s. 0d.

Style B.—Half leather and dark green cloth, lettered gold

Cost of Binding Case - - - -	4s. 9d.
Cost of Binding and Postage - - -	6s. 3d.
	11s. 0d.

Binding cases can be purchased separately if desired, and are obtainable from Richard Clay & Sons, Ltd.

The Institution is prepared to purchase copies of the following Journals at the prices given.

No. 160 (February 1937) - - - -	5s. 0d.
No. 150 (April 1936) - - - - -	5s. 0d.

Copies should be forwarded to the Secretary.

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In submitting names of candidates to prospective employers it is understood that the Institution accepts no responsibility and gives no guarantee.

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INSTITUTION NOTES.

DECEMBER 1937.

FORTHCOMING MEETINGS.

Tuesday, 11th January, 1938, at the Royal Society of Arts, John Street, Adelphi, W.C.2, at 5.30 p.m.

"The Application of Automatic Control to Refinery Process Operations," by S. W. Adey, A.R.C.S., B.Sc., A.I.C.

"Some Applications of Metering in Oilfield Operations," by Capt. D. Comins, M.C.

Tuesday, 8th February, 1938, at the Royal Society of Arts, John Street, Adelphi, W.C.2, at 5.30 p.m.

Meeting to be addressed by Lt.-Col. R. A. Thomas, C.B.E. (Home Office).

Monday, 28th February, 1938, at Burlington House, Piccadilly, W.1, at 8.0 p.m. Joint Meeting with the Society of Chemical Industry, Road and Building Materials Group.

Discussion on "The Ageing of Bituminous Materials."

NORTHERN BRANCH.

Wednesday, 19th January, 1938, Joint Meeting with the Society of Chemical Industry.

"The Application of Recent Chemical Research to the Improvement of Petroleum Products," by F. B. Thole, D.Sc., F.I.C., F.C.S.

Wednesday, 16th February. **"The Science of Lubrication,"** by Lt.-Col. S. J. M. Auld, O.B.E., M.C., D.Sc.

HONORARY MEMBER.

The Council has conferred Honorary Membership of the Institution upon :—

Dr. HASSAN SADEK BEY, B.Sc., Ph.D., during the tenure of his office as Director-General of the Survey and Mines Department of the Egyptian Government.

CANDIDATES FOR ADMISSION.

The following have applied for admission to the Institution or transfer to another grade of membership, and in accordance with the By-Laws the proposals will not be considered until after the lapse of at least one month subsequent to the issue of this Journal, during which any Member or Associate Member may communicate by letter to the Secretary, for the confidential information of the Council, any particulars he may possess respecting the qualifications or suitability of any candidate.

The object of this information is to assist the Council in grading candidates according to the class of membership.

The names of the candidate's proposer and seconder are given in each case.

BALFOUR, Nicholas Robert, Trainee (*Oil Well Supply Co.*), 33 Elizabeth Street, London, S.W.1. (*Ashley Carter.*)
BARRETT, Geoffrey Melvin, Engineer (*Asiatic Petroleum Co., Ltd.*), The Brown House, Meopham, Kent. (*N. Mitchell ; J. Kewley*) (*Trans. from Student*).
ETESSAM, Abdol H., Student (*University of Birmingham*), 128 Gough Road, Edgbaston, Birmingham. (*A. W. Nash ; L. V. W. Clark.*)
GRAY, Robert, Chemist (*Anglo-American Oil Co., Ltd.*), Yew Tree, West Malling, Kent. (*H. C. Tett ; C. Chilvers.*)
HORNE, Alan Bransby, Student (*University of Birmingham*), 143 Pershore Road, Edgbaston, Birmingham. (*A. W. Nash ; L. V. W. Clark.*)
KEMNITZER, William Johnson, Economic Geologist, 459 High Drive, Laguna Beach, California, U.S.A. (*J. Kewley ; A. E. Dunstan.*)
MANDELSTAM, Leopold Herman, Engineer, General Mining & Finance Corporation, Ltd., Winchester House, Old Broad Street, London, E.C.2. (*W. W. Connor ; T. S. Masterson.*)
MINA, Heshmat, Student (*University of Birmingham*), 75 Lonsdale Road, Harborne, Birmingham. (*A. W. Nash ; L. V. W. Clark.*)
MOAZAMI, Seifollah, Student (*University of Birmingham*), 353 Bristol Road, Birmingham. (*A. W. Nash ; L. V. W. Clark.*)
MOSTOFI, Baghis, Student (*University of Birmingham*), 222 Hagley Road, Edgbaston, Birmingham. (*A. W. Nash ; L. V. W. Clark.*)
REID, John William, Buyer (*Shell-Mex & B.P., Ltd.*), Glendale, 59 Chase Way, Southgate, London, N.14. (*A. Harland ; V. L. Johnson.*)
WELLINGS, Charles Edward, Student (*University of Birmingham*), 61 Broad Lane, Bradmore, Wolverhampton, Staffs. (*A. W. Nash.*)

ARTHUR W. EASTLAKE,

Honorary Secretary.

BRANCH NOTES.

MEETING IN CHICAGO.

The 2nd Annual I.P.T. Dinner in the United States was held on 10th November at the Stevens Hotel, Chicago. One hundred and thirty-eight guests were present.

The Chairman, Dr. E. L. de Golyer, was introduced by Dr. G. Egloff, who spoke on the international scope of the Institution and of the value of the Journal and its Abstracts Section.

Mr. D. G. Smith (Chief Research Chemist, The Anglo-Iranian Oil Company) spoke on " Co-operation in Research," and stressed the need for a closer working arrangement between laboratories, so as to eliminate duplication of work.

Dr. J. B. Hill, of the Sun Oil Company, emphasized the value of co-operative research on the lines of the fundamental researches on separation of the components of petroleum oils which were being carried out under an A.P.I. grant. He said that many compounds had now been isolated, which gave a clearer picture of petroleum oils than had been obtained before. Ultimately, with improved efficiency of fractionation and other physical methods, it may be found desirable to isolate commercially some of the individual components present in petroleum.

Mr. R. Stansfield, of the Anglo-Iranian Oil Company, spoke on the different conditions of motor car use in the United States as compared with England. He referred to the important co-operation which existed between the C.F.R. Committee of the Society of Automotive Engineers and the Knock-Rating Panel of the Institution.

Dr. C. K. Francis spoke on the Second World Petroleum Congress held in Paris in June 1937.

A short business meeting was held after the dinner by the members of the Institution, and it was agreed that the meetings of the I.P.T. in the United States (two of which have been held up to the present time) were highly successful, and that a third should be held during the A.P.I. meeting in Chicago in November 1938.

Roumanian Branch.

The 59th General Meeting of the Roumanian Branch was held on 14th October, 1937, at the Ploesti Chamber of Commerce, when Mr. E. Boaden, B.Sc., read a paper on " Deep Well Pumping."

At the 60th General Meeting of the Branch held on 18th November an important paper on " Pressure Maintenance Operations " was presented by Mr. P. Lambright, B.S.

Six papers have been presented to the Branch during 1937, and the Session has been an exceptionally successful one.

PERSONAL NOTES.

Mr. R. E. Adlington has returned from Iran.

Mr. R. P. Bolton has returned to Roumania.

Mr. T. W. Dagg has left for Trinidad.

Mr. L. V. A. Fowle is returning from Iraq.

Mr. W. E. Frankenburg is home from Egypt.

Mr. D. A. Greig is home from Italy.

Mr. J. S. Meredith has returned from Roumania.

Mr. T. G. Robson is returning from Assam.

Mr. R. K. Van Sickle is in Austria.

Correspondence or Journals forwarded to the following members has been returned, and the Secretary would be pleased to receive any information regarding their present address: C. T. Barber, A. G. Engelbach, R. Harman, A. D. Jones, J. Lander, A. P. Lieser, I. C. Low, I. Lusty, A. Maclean, S. Nicol, E. B. Sangster, F. J. Schneider, K. A. Spearing, and H. G. Spearpoint.

BINDING OF VOL. 23 (1937).

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